Fraunhofer
IVV

FRAUNHOFER INSTITUTE FOR PROCESS ENGINEERING AND PACKAGING IVV

ANNUAL REPORT

2018 | 2019

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„Network" © geralt - pixabay.com (S. 25)

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The Fraunhofer IVV

Detailed information about our business units and main fields of research can be found on our website.

www.ivv.fraunhofer.de

FOREWORD

Our focus in 2018 was once again the exploration of new opportunities and the continued development of our five business fields. As a research institute for process engineering and packaging we carry out pioneering work in the area of Food, Packaging, Product Performance, Processing Machinery, and Recycling and Environment. Our activities not only tackle current challenges but also cover topics of the future such as the bioeconomy, circular economy, and digitalization. We put the utmost importance on the applicability of our research findings: We develop customized solutions for a wide range of industries, take these through to commercialization, and also ultimately lay the basis for start-up companies.

Following these principles, we can report major successes this past year in each of our business fields.

Indeed, we are tackling one of the biggest issues of our time from several perspectives. In order to reduce food wastage, we are working as part of a research alliance to develop a mobile device for rapid determination of the quality of foods. This so-called food scanner should soon be able to estimate the shelf life along the value-creation chain. The basis of this rapid method is spectroscopic techniques. Promising results have already been achieved on selected foods.

We have also developed a mathematical model for shelf life simulation. This enables us to predict the shelf life of a wide range of products and at the same time make meaningful statements about optimal packaging for those products.

In the context of the new German Packaging Act, the recyclability of packaging has taken on increased relevance for packaging development work. Our expertise in the processing of plastics, the machinability of materials, and the evaluation of product protection provides extensive support for packaging and product manufacturers to develop new recyclable packaging materials and to integrate those materials into production processes. As such we are making a contribution to the strengthening of the Circular Economy.

In this context, our CreaSolv® recycling process is also a key element for sustainable industrial activity. In 2018 another big step was made here, with the Circular Packaging project constructing an industrial scale demonstration plant. Used packaging from mixed collections will be processed in this plant to produce high-quality packaging materials suitable for reuse. Compliance with EU regulations for food contact materials is a priority in this development work.

Two similar successes from our Food business field also deserve mention. Following the expansion of our food pilot plant facilities, we can now manufacture product samples that meet the very latest hygiene standards for test markets of our partners in the food sector. Elosun, a spin-off of

the Fraunhofer IVV, produces and markets plant proteins from sunflower seeds and has firmly established itself in the marketplace: Just recently food manufacturer Zentis invested a seven figure sum into the young company and will in the future use the process we developed for its products.

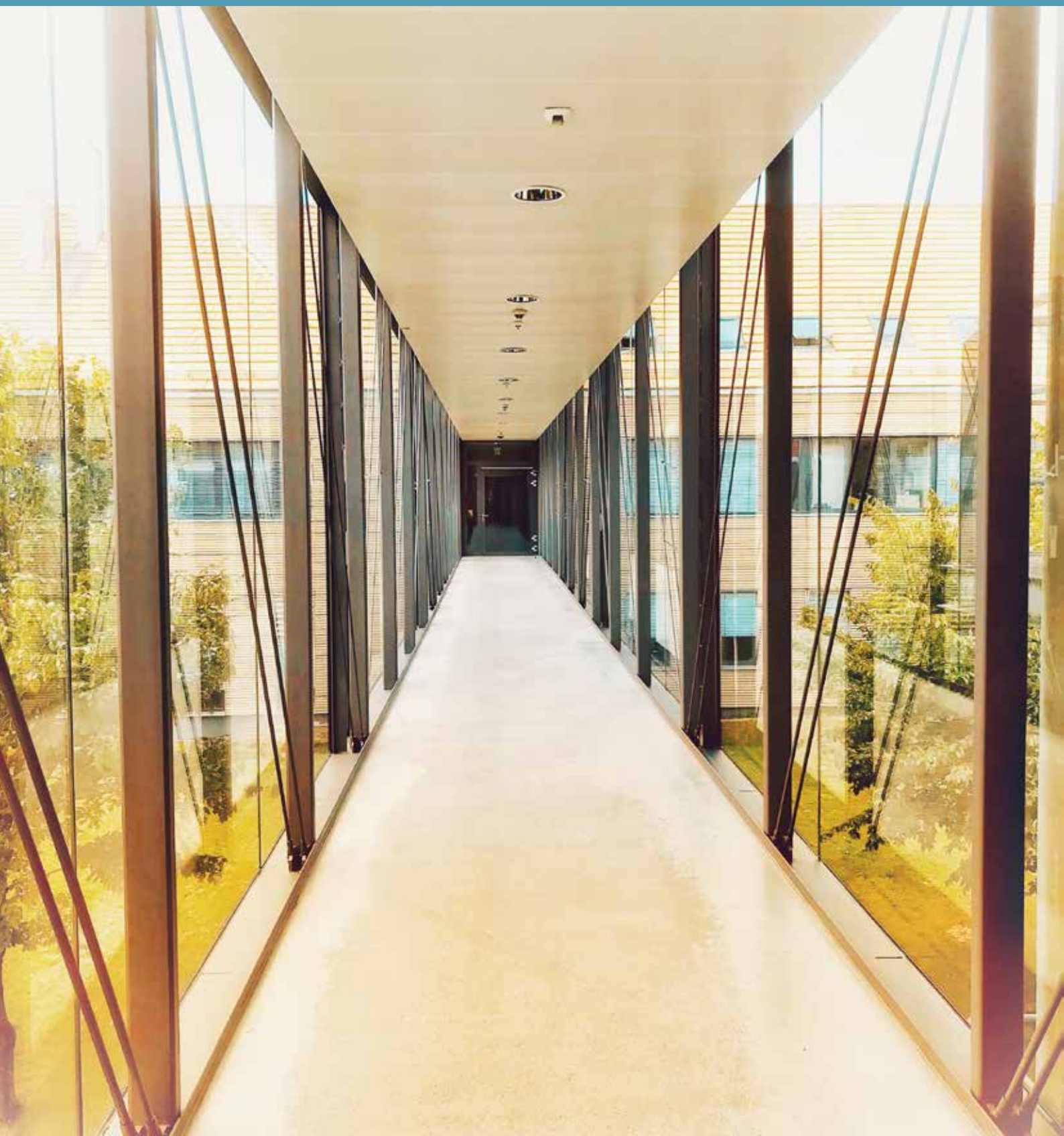
Our Product Performance business field has the ambitious goal of measuring the sensory properties of products in their totality. Based on techniques used for flavor research in foods, we are developing new analytical methods that in the past year have been successfully used to identify harmful materials in children's toys. The provision of new technologies and services relating to human sensory perception is also an objective of the Campus of the Senses initiative that was jointly set up by the Fraunhofer IVV. The focus is the development of multisensory digital systems that can understand and simulate human sensory perception.

The buzzword digitalization must be mentioned in connection with our development work on cleaning technologies. The Fraunhofer IVV Dresden has developed a mobile cleaning device for processing plants that combines the flexibility and efficiency of manual cleaning with the reproducibility and reliability of integrated CIP systems. The use of an optical contamination sensor enables, for the first time, total quality control and documentation of cleaning processes.

Many other interesting developments are planned. We would like once again to express our appreciation to all our customers and partners in industry, to the universities and research organizations with whom we collaborate, and to all the bodies who provide funding for our work.

Prof. Dr. Horst-Christian Langowski
Institute Director

MISSION STATEMENT



The Fraunhofer IVV stands for high-quality food products and safe, effective, and convenient packaging systems.

Efficient use of raw materials and minimal environmental impact are priorities in all our development work.

We also transfer our technologies and expertise to applications outside the food and packaging industries.

Companies and research organizations appreciate the Fraunhofer IVV as a business partner.

People are inspired by our research work and the resulting products.

BUSINESS UNITS AND THEIR SERVICES

Food - Product Performance - Packaging - Processing Machinery - Recycling and Environment

FOOD

Our new developments and reformulated foods focus in environmental and health aspect. We offer a comprehensive range of services along the entire production chain covering food safety, quality, and sensory evaluation.

- Development of food products, e.g. replacement of animal proteins by plant-based proteins in convenience products
- Recovery of functional ingredients for specific applications, e.g. plant proteins as an egg substitute
- Assurance of food quality
- Simulation-based prediction of shelf life
- Analytics in the area of food safety
- Optimization of aroma, taste, and texture
- Cleaning systems for hygienic production

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PRODUCT PERFORMANCE

The perception of a product directly influences the decision of consumers to buy a product. We therefore evaluate and optimize sensory properties for all of the senses.

- Sensory optimization of foods and packaging
- Optimization of the odor of consumer products and raw materials
- Multisensory evaluation of product properties
- Identification of potential physiological irritants in materials and products
- Development of customized sensory test systems
- Digital recording and simulation of sense perception as part of the „Campus of the Senses“initiative

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PACKAGING

We develop customized packaging systems for a variety of industrial products. We also offer a wide spectrum of services in the area of quality assurance. Our test laboratories are accredited by DAkkS.*

- Development of packaging materials and technical films having defined functional properties
- Optimization of packaging systems via software-based prediction of the shelf life
- Development of recyclable laminates
- Easy-opening concepts
- Tests on packaging materials
- Compliance and migration tests
- Optimization of packaging machinery

**in accordance with DIN EN ISO/IEC 17025 (as specified in the annex to the certificate D-PL-11140-04)*

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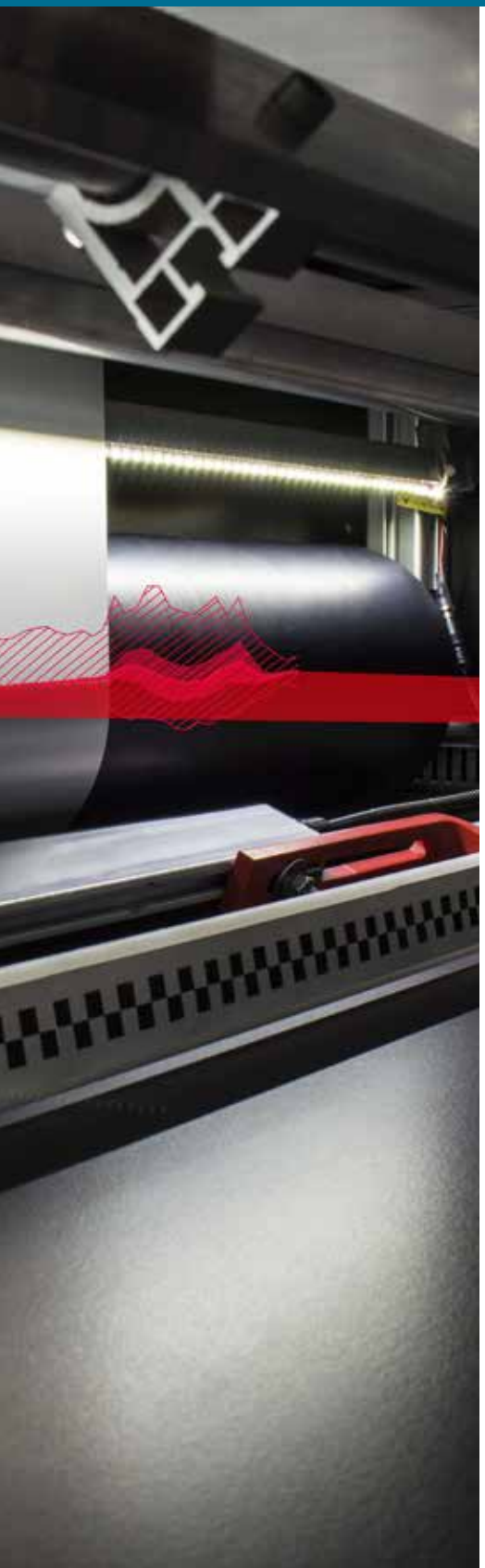

Product safety and production efficiency are the most important aspects of our development work in this business field. Hybrid technology concepts and new solutions using digitization allow us to meet today´s ever growing challenges.

- Analysis of plant efficiency
- Development of assistance systems for machine operators
- Evaluation of the machinability of flexible packaging materials
- Optimization of forming, sealing, and welding processes
- Development of cleaning systems
- Design of hygienic processes
- Digital solutions for Industry 4.0 concepts

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RECYCLING AND ENVIRONMENT

Our patented CreaSolv® recycling process allows the recovery of high quality recyclates from plastic-containing waste. To promote the bioeconomy we replace fossil raw materials with plant-based materials recovered from byproduct streams.

- New processes for recycling plastics and metal-plastic composites
- Optimization of recycling plants and processes
- Sensory optimization of recyclates
- Recovery of plant proteins with customized functionalities for technical products, e.g. surfactants
- Development of bio-based products from raw and waste plant materials, e.g. additives for lubricants
- Environmental analyses for containments and hazardous materials

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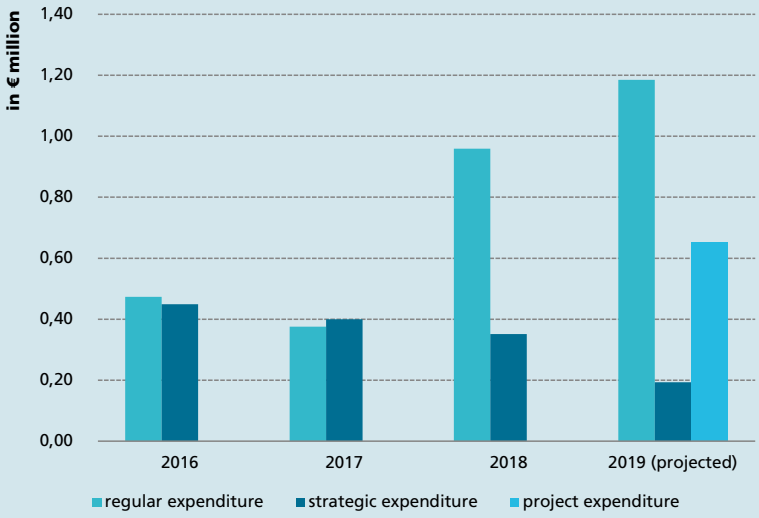
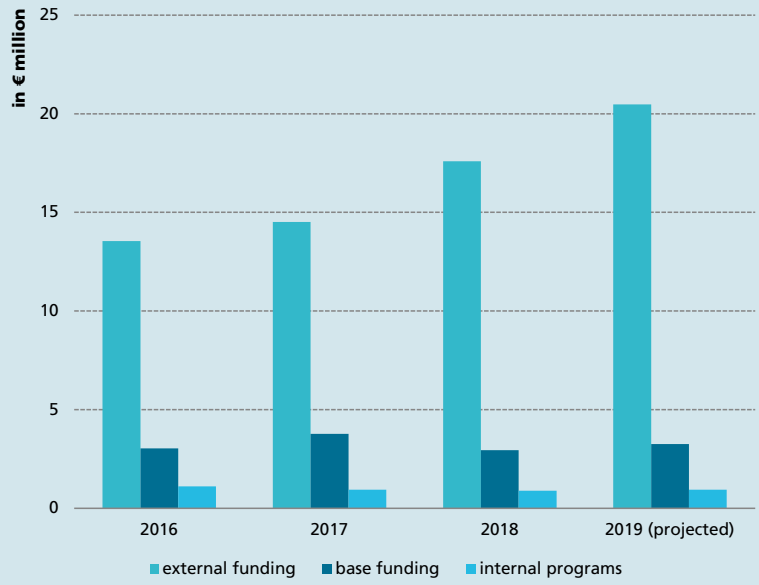
FRAUNHOFER IVV IN FIGURES

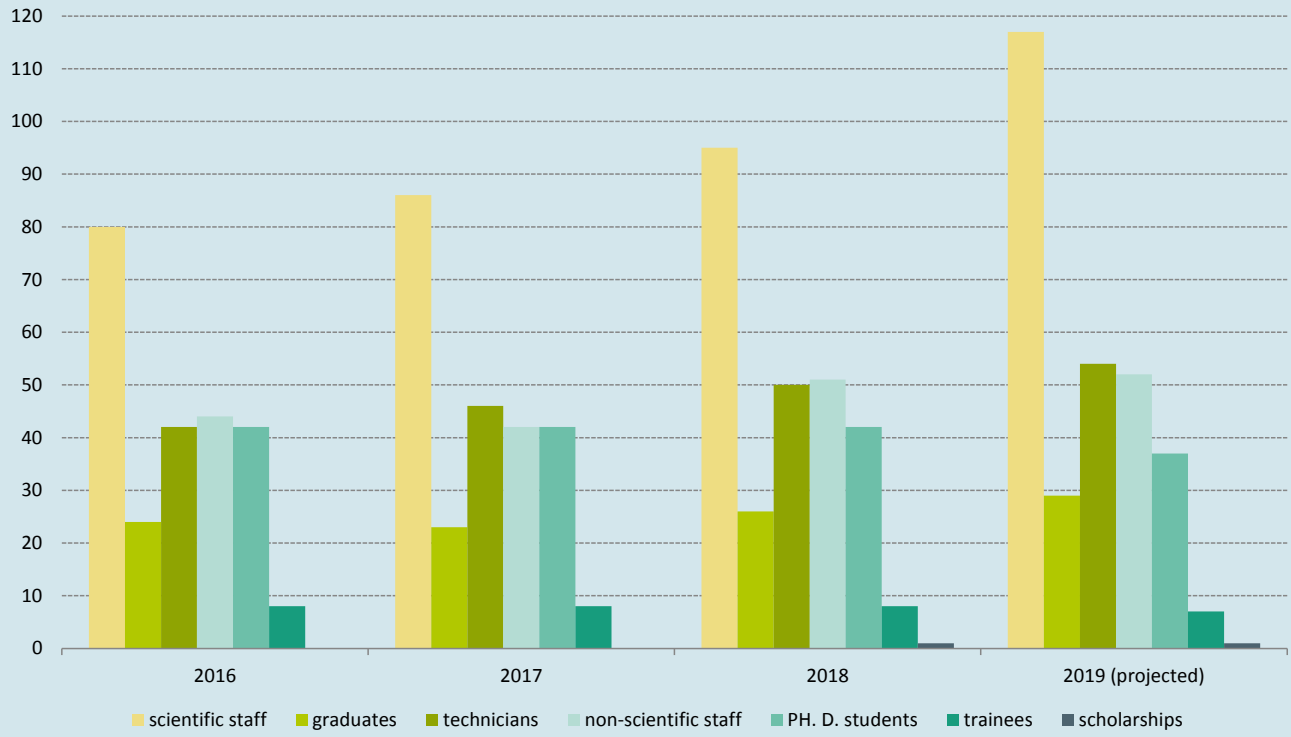
Expenditure



Operating income



Members of staff



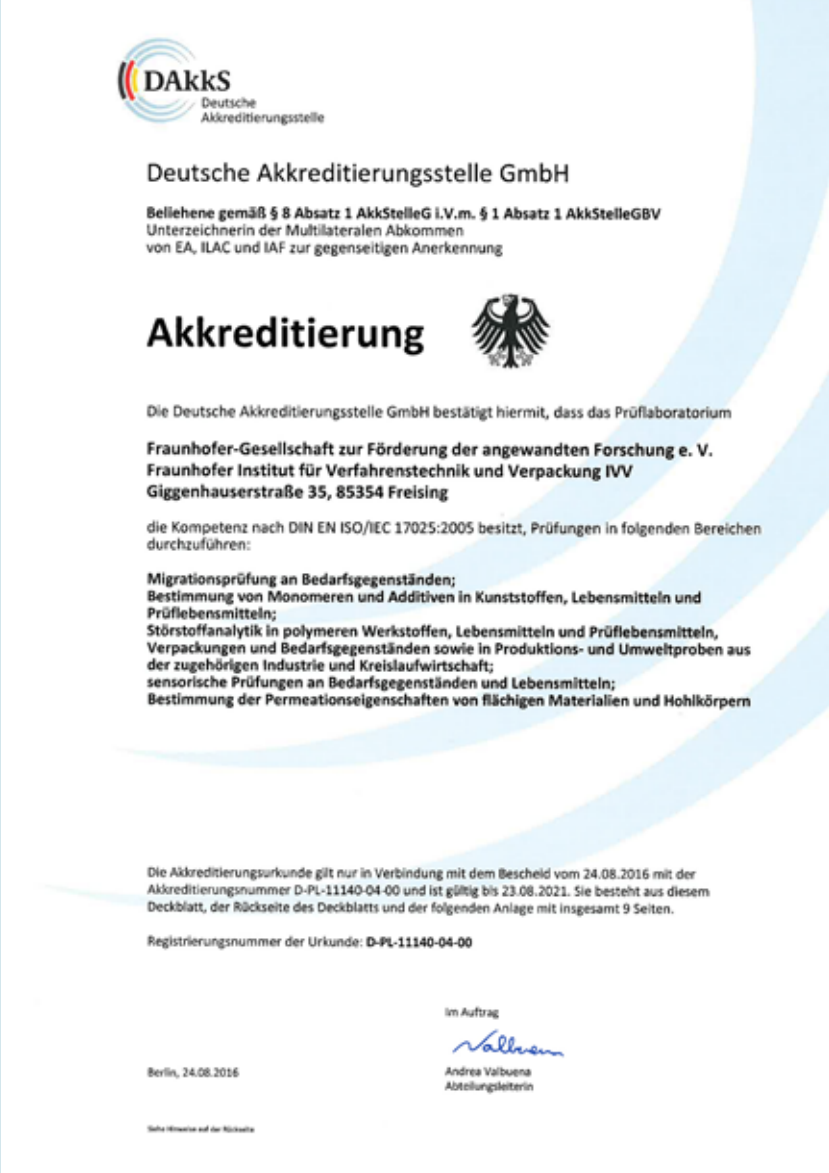
QUALITY MANAGEMENT

The Fraunhofer IVV has been accredited since 1996 for performing migration tests. The scope of the accreditation has been gradually extended to include permeation tests for oxygen and water vapor, the analysis of contaminants in polymer, food, and environmental samples, and sensory tests on consumer products and foods.

In order to provide customized services within the scope of the accredited system we have included the development of new analytical methods for migration testing and contaminant analysis in the quality management system and we have flexible accreditation in these areas.

The quality management system meets the requirements of DIN EN ISO/IEC 17025:2005 and hence also the requirements of ISO 9001:2000 for test laboratories.

Our test laboratories were reaccredited in 2016 by DAkkS (accreditation certificate D-PL-11140-04-00). Currently we are adapting the quality management system to the new DIN EN ISO/IEC 17025:2018 standard.



DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.
Fraunhofer Institut für Verfahrenstechnik und Verpackung IVV
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die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Migrationsprüfung an Bedarfsgegenständen;
Bestimmung von Monomeren und Additiven in Kunststoffen, Lebensmitteln und Prüflebensmitteln;
Störstoffanalytik in polymeren Werkstoffen, Lebensmitteln und Prüflebensmitteln, Verpackungen und Bedarfsgegenständen sowie in Produktions- und Umweltproben aus der zugehörigen Industrie und Kreislaufwirtschaft;
sensorische Prüfungen an Bedarfsgegenständen und Lebensmitteln;
Bestimmung der Permeationseigenschaften von flächigen Materialien und Hohlkörpern

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 24.08.2016 mit der Akkreditierungsnummer D-PL-11140-04-00 und ist gültig bis 23.08.2021. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 9 Seiten.

Registrierungsnummer der Urkunde: **D-PL-11140-04-00**

Im Auftrag

Berlin, 24.08.2016

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FRAUNHOFER PROJECT CENTER FOR INNOVATIONS IN FOOD AND BIORESOURCES IN BRAZIL

The Fraunhofer Institute for Process Engineering and Packaging has set up a joint work group with the Fraunhofer Project Center for Innovation in Food and Bioresources at ITAL (Institute for Food Technology) in Campinas (São Paulo, Brazil) to study the processing of high-quality raw materials and foods such as coffee, chocolate, and tropical fruits and to study the utilization of biogenic raw materials and residual materials for industrial applications.

The founding of the Fraunhofer Project Center in December 2013 extends the longstanding scientific collaboration in the area of packaging between the institutes with the following four topics:

- Functionality, nutritional value, and health aspects of foods
- Quality and sensory analysis of foods
- Bioenergy and materials from renewable raw materials
- Innovative packaging systems

The Fraunhofer Project Center (FPC) provides the framework for joint research projects involving the two institutes. The aim is to develop innovative products and processes and to assist SMEs in both countries by carrying out application-oriented development projects. This collaboration is a response to the challenges of globalization and offers partner companies in both countries new opportunities for international networking and access to new markets.

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KLEVERTEC - COMPETENCE CENTER FOR APPLIED RESEARCH IN FOOD AND PACKAGING TECHNOLOGY

Starting in September 2015, the Fraunhofer IVV and Kempten University of Applied Sciences began setting up a Competence Center for Food and Packaging Technology in Kempten.

The focus of the so-called KLEVERTEC Competence Center is the shelf life, quality stability and safety of food products. The applied R&D work involves economically viable, eco-compatible product innovation in the area of food production, filling, and packaging. The emphasis is on milk and dairy products as well as beverages, namely established products of the Allgäu region of southern Germany.

KLEVERTEC collaborates with IHK Schwaben (Chamber of Commerce Swabia), Milchwirtschaftlicher Verein Bayern e. V., and ZLV – Zentrum für Lebensmittel- und Verpackungstechnologie e. V., so forming a strong network which particularly benefits medium-sized companies. The Competence Center offers students the opportunity to participate in ongoing projects, so contributing to their practical training.

Project work in collaboration with industry started in the premises of KLEVERTEC in June 2016. The KLEVERTEC project is being funded by the Bavarian Ministry of Economic Affairs and Media, Energy and Technology and the Bavarian Ministry of Education and Culture, Science and the Arts.

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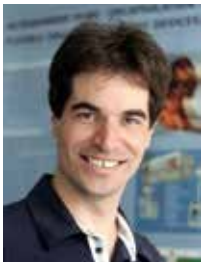
KLEVERTEC
KOMPETENZZENTRUM FÜR ANGEWANDTE FORSCHUNG IN DER LEBENSMITTEL- UND VERPACKUNGSTECHNOLOGIE

Fraunhofer IVV | Hochschule Kempten University of Applied Sciences

DOCTORAL THESES

2017

Raffael Osen
Texturization of pea protein isolates using high moisture extrusion cooking
Technische Universität München, Chair of Food Packaging Technology



Oliver Miesbauer
Analytical and numerical calculations of the barrier effect of multilayer structures
Technische Universität München, Chair of Food Packaging Technology

Isabel Muranyi
Properties of protein isolates from lupin (Lupinus angustifolius L.) as affected by the isolation method
Technische Universität München, Department of Food Chemistry

Daniela Leistl
Development of an enzymatic de-acidification step for the improvement of rapeseed oil refining and simultaneous enhancement of diacylglycerol in the edible oil
Technical University of Dortmund, Faculty of Biochemical and Chemical Engineering

Johannes Bott
Studies on the migration of nanomaterials from plastic food packaging
Technische Universität München, Chair of Food Packaging Technology

Lukas Oehm
Joining of polymer films with high-intensity focused ultrasound
Technische Universität Dresden

2018

Markus Schmid
Interaction-property relationships of whey protein based films and coatings
Technische Universität München, Lehrstuhl für Lebensmittelverpackungstechnik

Maria Hoppe
Oligomers in polyester-type food contact polymers: Identification and migration studies
University of Amsterdam, Faculty of Science

Sven Sängerlaub
Water vapor sorption in polymer films with dispersed sorbents
Technische Universität München, Chair of Food Packaging Technology

Judith Wittenauer
Characterization, isolation, and stabilization of plant-based ingredients for cosmetics' manufacture
University of Hohenheim, Faculty of Natural Sciences

FRAUNHOFER NETWORKS AND ALLIANCES

COMBINED EXPERTISE

Close collaboration in networks and alliances is a way of bringing together the expertise of the Fraunhofer Institutes. The latest scientific findings in different areas are utilized in joint project and development work. The Fraunhofer Institute for Process Engineering and Packaging IVV is a member of the following networks and alliances of the Fraunhofer-Gesellschaft.

Fraunhofer Food Chain Management Alliance (FCM)

The Fraunhofer Polymer Surfaces Alliance (POLO) combines the know-how of seven Fraunhofer Institutes. Optimal utilization of synergies allows innovative concepts to be developed for the functionalization of polymer surfaces. One main area of research is the development, manufacture and characterization of flexible ultra-barrier laminates.

Fraunhofer Polymere Surfaces Alliance (POLO)

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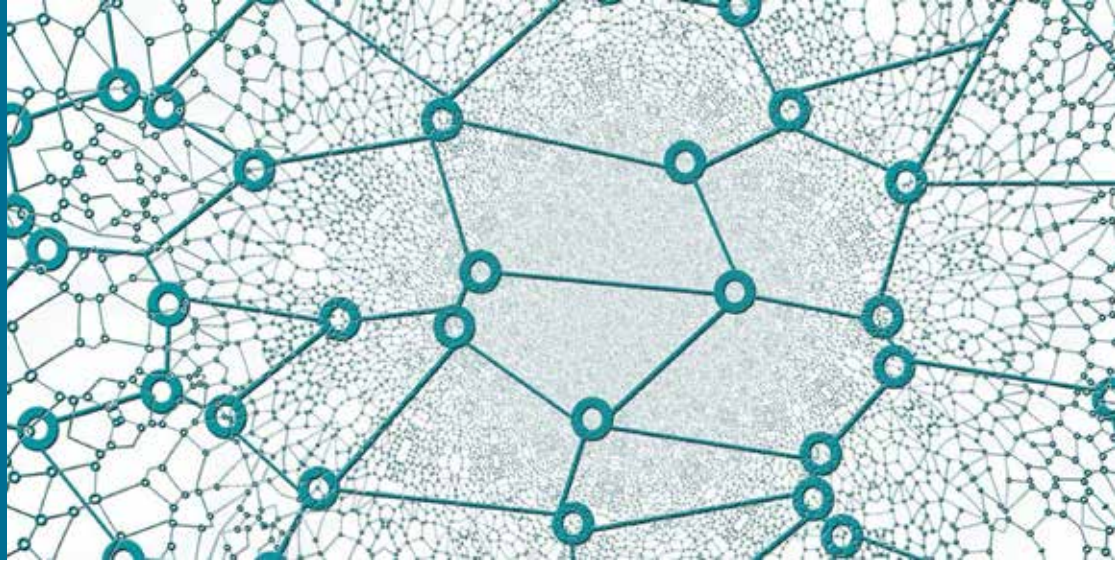
Fraunhofer Big Data Alliance

The Fraunhofer Big Data Alliance is made up of 29 separate institutes harnessing their expertise across all sectors. Fraunhofer experts not only help companies develop big data strategies, software packages and data protected big data systems but they also train specialists and managerial staff to become »data scientists«.



Fraunhofer Nanotechnology Alliance (NANOTECH)

In this alliance the activities of 20 Fraunhofer Institutes focus on the following key areas: multifunctional layers for the automotive applications, the design of special nanoparticles for biotechnology and medicine as well as the use of carbon nanotubes for actuator applications. In the packaging sector, polymer films for nanoscale structures (particles and layers) are being developed.

Fraunhofer Cleaning Technology

The Fraunhofer Cleaning Technology Alliance unites the competences of nine Fraunhofer Institutes. The cooperative objective is the industrial cleaning of surfaces along the whole process chain.

Fraunhofer Group of Life Sciences VLS

The Fraunhofer Group for Life Sciences brings together the biological, biomedical, pharmacological, toxicological and food technology expertise of six institutes in the Fraunhofer-Gesellschaft. Being the largest independent research organization in Europe, the Fraunhofer Institutes develop market-oriented solutions to meet the specific requirements of customers. A solid basis for this is our own preliminary research which investigates fundamental principles and which is often carried out in collaboration with universities and technical colleges.

www.ivv.fraunhofer.de/networks

BOARD OF TRUSTEES

The Board of Trustees comprises representatives from the worlds of science, industry and public office. The trustees are appointed by the Executive Board of the Fraunhofer-Gesellschaft. The Board of Trustees advise the institute management and committees of the Fraunhofer-Gesellschaft on important matter and foster links to parties interested in the R&D word of the institute.

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Status as of January 2019

THE FRAUNHOFER-GESELLSCHAFT

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains 72 institutes and research units. The majority of the more than 26,600 staff are qualified scientists and engineers, who work with an annual research budget of 2.6 billion euros. Of this sum, 2.2 billion euros is generated through contract research. Around 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Around 30 percent is contributed by the German federal and state governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.

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.

www.fraunhofer.de

Figures are for January 2019.