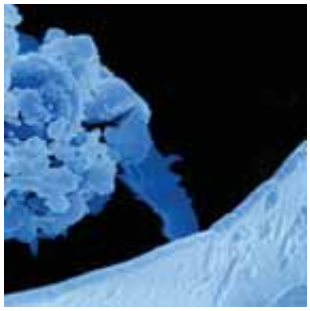
IUSE

Fraunhofer Institut
Umwelt-, Sicherheits-,
Energietechnik UMSICHT

2004

Annual Report 2004

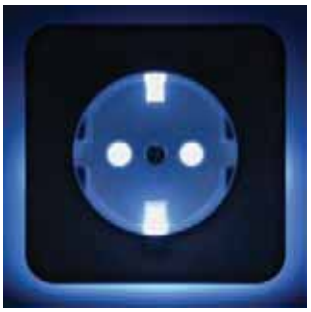


Matfunc

Key Research Areas:



Biorefinery



Vision Energy 21



Networks

Fraunhofer UMSICHT –
Technology, that pays!

Business Unit
Renewable Resources

Bioengineering
Plastics Technology
Resource-efficient Products



Business Unit
Process Technology

Membrane Technology
High-pressure Technology
Reaction Engineering



Business Unit
Waste Management/-Technology and Adsorption

Material Flow Management
Sorption Technology
Waste Disposal Management



Business Unit
Advanced Materials

Smart Materials
Particle Technology
Analytics/Modeling



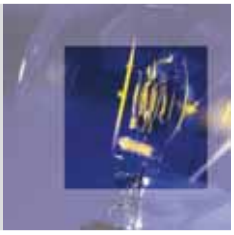
Business Unit
Safety Engineering

Fire and Explosion Protection
Information Management
Hydraulic Systems



Business Unit
Energy Technology

Energy Process Engineering
Gasification, Gas Upgrading
CHP – Combined Heat and Power



Business Unit
Energy Systems

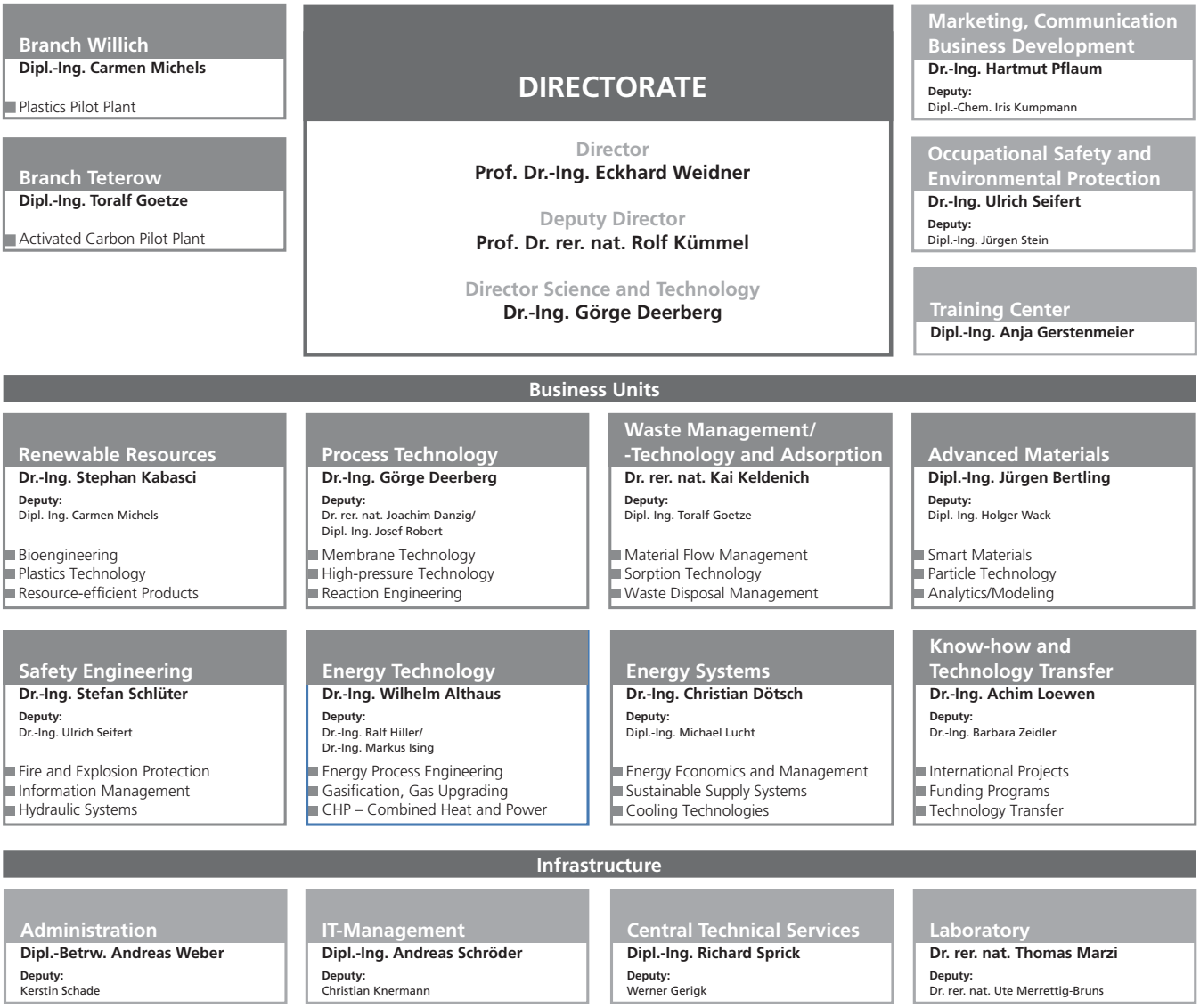
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Sustainable Supply Systems
Cooling Technologies



Business Unit
Know-how and Technology Transfer

International Projects
Funding Programs
Technology Transfer

Alles auf einen Blick: Das Organigramm



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At Fraunhofer UMSICHT, the year 2004 was characterized by developing new, promising fields of activity from previously built competences and, at the same time, increasing scientific excellence.

The changed structure of the institute with eight future-oriented business units and several centralized departments has passed its first test. It allows the areas environment, energy and process safety to flexibly adjust to new developments, gives the particularly creative members of the UMSICHT team more freedom to design, and makes the evaluation of profit contribution and efficiency of the individual working groups easier. Through the development of the key research areas "Biorefinery", "Vision Energy 21", "Functional Materials" and "Networks", science guidelines have been created, which help create current trends and steer UMSICHT expertise to new, promising areas. They catalyze collaboration across business units as well as cooperation with other Fraunhofer institutes. This becomes evident within the Fraunhofer Alliance Production, in the alliances for energy, numerical simulation and nano technology, in working on the WISA* "Micro-structured composite particles", and in the participation in the portfolio process of the Fraunhofer-Gesellschaft.

The traditional UMSICHT-days, which were held under the theme "Bio – refined" for the second time, are an encouraging sign for the opportunities that the integrated material and energetic utilization of biological raw materials offers. As a result, numerous potential partners from different areas of Germany were brought together. UMSICHT employees received specific achievement awards and innovation prizes for the decontamination of art treasures contaminated with wood preservatives, for the simulation of the extraction of oceanic gas hydrates, and for a recipe for biodegradable plastic cutlery.

*WISA = market-oriented strategic alliances of the Fraunhofer-Gesellschaft

Fraunhofer UMSICHT is characterized by a high proportion of industry projects in its total revenue. Strategic alliances with high-performance industrial partners have to be increasingly sought and forged. It is delighting that UMSICHT succeeded in acquiring several larger projects from the EU, the BMBF (= Federal Ministry of Education and Research), state ministries, and from industrial community research despite the tough competition for decreasing research funds.

The arrangement of the succession for the institute leadership and the associated stronger relationship of the institute with the Ruhr-University Bochum and the scientific region Ruhr as a whole are a very significant result of the passed year. The chances for continuation and expansion of UMSICHT's portfolio and for the scientific qualifications of the employees that are created will become clearer in the following months. The institute expansion, generously funded by the state of North Rhine-Westphalia and the Fraunhofer-Gesellschaft, creates beneficial boundary conditions for UMSICHT's path ahead.

The presented annual report 2004 briefly introduces a selection of the areas of work. We are grateful to our employees for their dedication and effort, and to our numerous business partners, clients, and customers, the members of the UMSICHT-Board of Trustees, the circle of friends and patrons, and all other collaborators. We are looking forward to the year 2005 and thank you for your support and consideration.

We wish you an inspiring lecture.

Your



Eckhard Weidner



Rolf Kümmel



On the occasion of the Year of Technology, the exhibition-ship MS Technik (technology) is touring Germany from June until October with a great deal of research and science on board. Micro-particle pinball is an attraction for old and young and demonstrates in a playful way that precisely tailored micro-particles can give a pinball unusual characteristics.





Under the motto "Bio-refined", everything revolves around renewable resources and their path from the field to industry.
Minister Bärbel Höhn (MUNLV NRW) opens the UMSICHT-Days 2004 and is glad to see that many girls are "a step ahead" during the tour through the laboratories and workshops on the second day of the event.







Three is a charm. In September, the FKuR Kunststoff GmbH from Willich together with Fraunhofer UMSICHT are being awarded the third place of the IHK-Research and Innovation Price for the biodegradable plastic cutlery formula they developed.

Highlights 2004

"Plastics – naturally!" is the motto of the K 2004, the international exhibition for plastics and rubber in October. Usable, biodegradable plastics from renewable resources were the big hit at the booth of FKuR Kunststoff GmbH and Fraunhofer UMSICHT. That is no surprise because they offer a natural way to conserve resources and reduce costs.





In November, Prof. Dr.-Ing. Eckhard Weidner takes his position as the new Fraunhofer UMSICHT institute director. At an institute meeting which Dr. Dirk-Meints Polter, Head of Human Resources and Legal Affairs of the Fraunhofer-Gesellschaft, attends, he introduces himself to the team.
(F.l.t.r: Prof. Dr. Rolf Kümmel, Prof. Dr. Eckhard Weidner, Dr. Dirk-Meints Polter, Dr. Görge Deerberg)

The Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT



The industrial nations of today owe their convenient living conditions to the, at all times, sufficient production of economic goods, the secure production and distribution of energy, as well as the free exchange of information.

Production and consumption are embedded in an economic system, which presupposes economic growth and competition and an ecological system whose absorption and provision capacities are limited.

Fraunhofer UMSICHT

Which makes apparent:
Technological progress is the engine for every modern industrial society. Technological innovations help making efficient and safe use of resources and energy resources. They allow a satisfactory and inexpensive production of innovative goods and create and secure competitive jobs.

In this context Fraunhofer UMSICHT develops and researches the latest knowledge and transfers it into industrial applications and marketable products.

Eight specialized business units are the basis for the institute's multi-faceted, development competence in process engineering. Thus, the institute can serve as a one-stop-shop for its clients.

Whether the customer is a small or medium-sized company, a major enterprise or a public institution, the institute's motto applies to all of them:

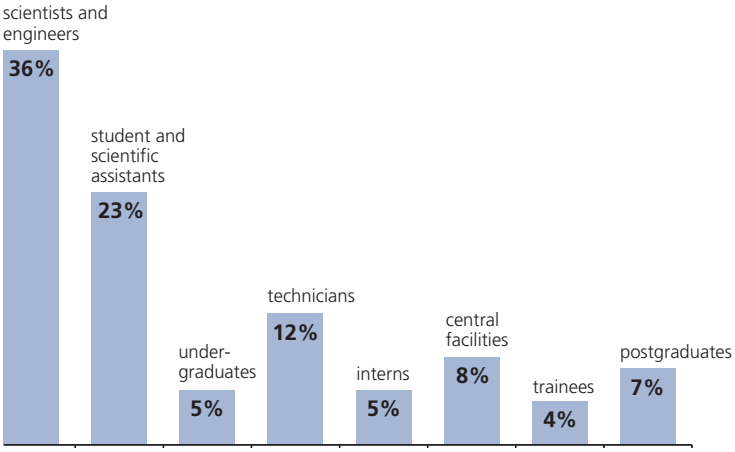
Fraunhofer UMSICHT –
Technology that pays!

As a member of the Fraunhofer-Gesellschaft the institute follows the tradition of applied research and development, close to the market.

As a catalyst for science and economy, Fraunhofer UMSICHT engages in the structural change of the city and the region with new ideas, technology transfer, spin-offs and the formation of R&D networks.
Internationally, the institute operates in the states of central and Eastern Europe, in the Americas as well as in Asian countries.

Staff

Staff at Fraunhofer UMSICHT 2004	Number
Permanent Staff	**137**
- Scientists and engineers	88
- Technical infrastructure	30
- Central services	19
Other Staff	**105**
- Postgraduates	16
- Undergraduates	12
- Student assistants	56
- Interns, guest scientists	11
- Trainees	10
Total Staff	**242**

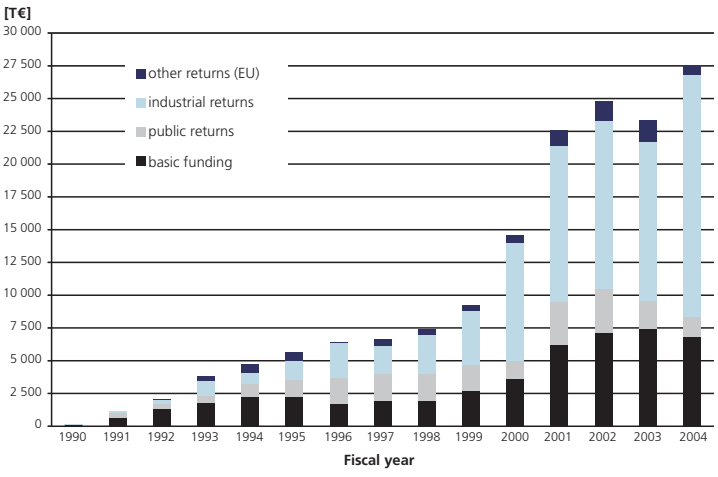


Structure of staff at Fraunhofer UMSICHT

Expenditure and returns

Expenditure 2004	(m €)
Operational Budget	**27.5**
- Staff costs	8.7
- Other costs	18.8
Investments	**0.4**

Returns Operational Budget 2004	(m €)
- Industrial returns	18.4
small and medium-sized enterprises	15.2
large enterprises	3.2
- Public returns	1.6
- Others (EU, communities)	0.7
- Basic funding	6.8
Total Returns	**27.5**



Development of the operational budget since the establishment of the institute

Guidelines

The guidelines of the organization "Fraunhofer UMSICHT" describe the basic self-conception of the Institute and its staff. Therefore, they are kept in a general form and build a frame which is to be completed and acted out but which also is to be advanced.

Guidelines are to bring continuity and stability into dynamically changing requirements of environment and daily routine. They are to accompany the institute's work beyond office hours and are to be communicated inside and outside the institute. Thus, mission, policies, and expectations the institute operates with and wants to be perceived in its surroundings with are reflected in the guidelines.

The ten guidelines of the organization "Fraunhofer UMSICHT" are deduced from the regulations and guidelines of the "Fraunhofer Gesellschaft" and concretize them for the concerns of the institute's work.

1 Fraunhofer UMSICHT sees itself as a link between its business partners, staff members, the "Fraunhofer Gesellschaft", the scientific community, and other social actors.

2 Fraunhofer UMSICHT wants to be a reliable research and development partner for its clients, relieve them during all project phases, give them all respective services from one hand, and support them in accessing subsidies and commercial funding.

3 Fraunhofer UMSICHT offers its clients high-quality scientific, results-oriented, interdisciplinary, and innovative research and development work. It provides them with competitive advantages through advance in know-how and recognized competence in problem solving.

4 The staff members form the institute's backbone. Fraunhofer UMSICHT encourages and challenges the staff's professional, scientific, entrepreneurial, and social skills. These skills determine the institute's efficiency. Fraunhofer UMSICHT wants to fill its staff with enthusiasm for research and development.

5 Fraunhofer UMSICHT acts according to the principles of the "Fraunhofer Gesellschaft" and contributes to enhancing the reputation of the "Fraunhofer Gesellschaft". The institute cooperates in partnership with the board of directors, headquarters, and other Fraunhofer institutes and facilities.

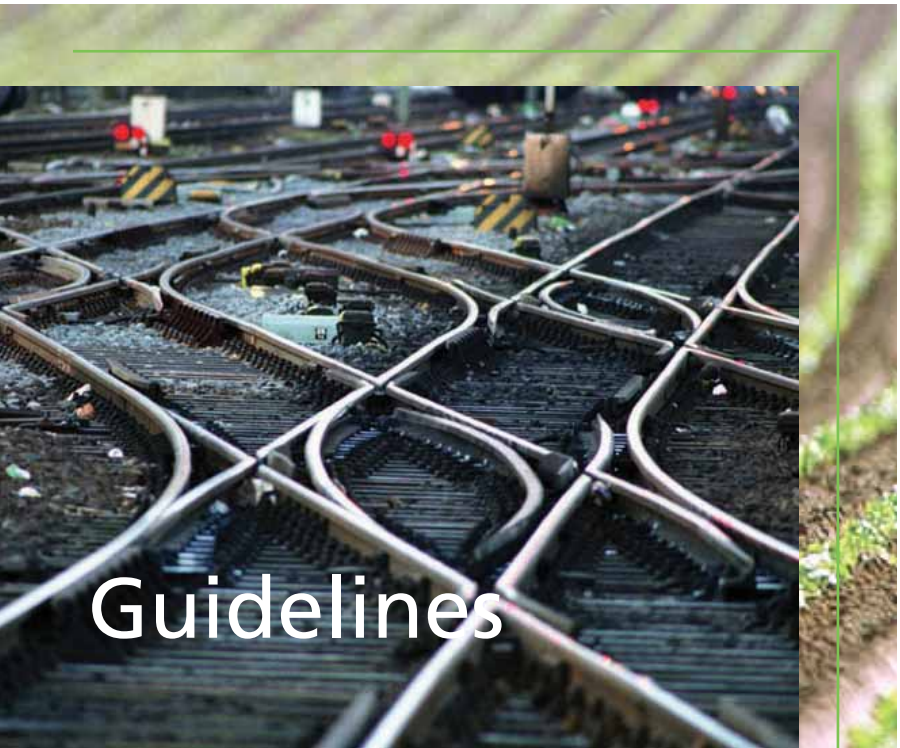
6 Fraunhofer UMSICHT is actively committed to the formation of strategic alliances and networks in economy, science, politics, and society.

7 Fraunhofer UMSICHT forces up activities abroad in respect of project work and exchanging staff members (know-how transfer).

8 Fraunhofer UMSICHT acts actively in the scientific community. The institute cooperates with other research facilities, universities, technical colleges, and industrial partners in the national and international research and development scene, and faces up to scientific debate.

9 Fraunhofer UMSICHT is independent. It supports clear, understandable, and interdisciplinary consolidated positions and aligns its objectives according to these positions. Fraunhofer UMSICHT aims at a long-term realization of social visions through concrete innovations which can be efficiently transfered into economically utilizable progress and can be transfered into the environment.

10 Fraunhofer UMSICHT sees itself as a pathfinder for technical changes in the areas of environment, energy, process engineering, and safety. The institute promotes effective management, environmentally friendly technologies, and environmentally conscious behavior in order to enhance society's overall quality of life.





Strategy

Strategy needs Implementation: Accomplishments to Date

The essence of knowledge is, having it, to apply it ...
[Confucius]

While the year 2003 was characterized by the completion of the first version of the strategy plan, 2004 was spent implementing several measures in order to progress towards the newly set goals. In retrospect, the list of measures reflects the transitional process, which drives Fraunhofer UMSICHT.

Important milestones were the succession of the institute's leadership through Professor Weidner and the associated scientific partnership with the Ruhr-University Bochum, the strategic integration of the institute into the Fraunhofer Alliance "Production", the introduction of a market-oriented business structure, the successful increase of foreign activities, and the realignment of content based on four key research areas.

The internal focus area process, which is geared towards the portfolio process of the Fraunhofer Gesellschaft, embodies the departure to new R&D markets for the scientific positioning of Fraunhofer UMSICHT. Innovative developments from comprehensive teams are defined in the following areas:

Biorefinery
Products from renewable resources
MatFunc
Functionalized materials, membranes und particles
Vision Energy 21
On the way to the hydrogen economy
Networks
Creating integrated production networks

For the future, the institute is building on six strategic pillars:
1. Fraunhofer UMSICHT delivers research and development services to industry.
2. Fraunhofer UMSICHT defines and realizes research goals with public funding.
3. Fraunhofer UMSICHT develops technologies for the production of specialty products on a demonstration and sample scale.
4. Fraunhofer UMSICHT is competent in plant engineering and construction.
5. Fraunhofer UMSICHT offers studies and expert opinions for decision-makers in politics, public administration, and economic development etc.
6. Fraunhofer UMSICHT is active in offering continuing education, seminars, workshops etc.

Change is also at hand for the year 2005: In the course of the institute's expansion, investments will be made for new equipment and plants, the strategy plan will be revised, and a spin-off concept will help stimulate the entrepreneurial side of innovation. The area "training center" will complement the Fraunhofer network. The heart of Fraunhofer UMSICHT beats for knowledge and its implementation.

Your contact

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Key Research Areas

The key research areas stand for the activities of the institute. UMSICHT can be identified by them and should identify itself with them. They have scientific as well as economic viability and fit into the profile of the Production Alliance of the Fraunhofer-Gesellschaft and the Fraunhofer-Gesellschaft as a whole.

Sustainable development continues to garner economic and scientific interest since conserving resources and acting economically sensible go hand in hand. Sustainability in production and in supply of energy as well as in intelligent products is a challenge for the future that Fraunhofer UMSICHT is taking head-on.

In this context, four different key research areas are developing:



Key Research Area "Biorefinery"

The term biorefinery stands for an integrated concept for the biochemical and thermochemical conversion of renewable raw materials to chemicals, new materials, and fuels with the goal of complete utilization of the biomass.

Starting from the product side of the biorefinery, the focus of the key theme is on the process chains and key technologies for the production of biochemicals, biomaterials, and biofuels. This entails solving research and development challenges with regard to the key technologies, which are necessary for the realization of biorefineries. An emphasis is put on:

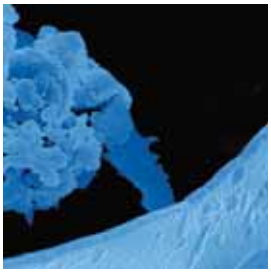
- Production of biochemicals through fermentation processes and their concentration and cleaning processes
- Conversion of biomass-based substances with high molecular weights (biopolymers*) into materials and finished products
- Biofuels such as biodiesel and ethanol, which can be extracted from synthesis gases



Key Research Area "MatFunc"

In the context of the key research area, the development and manufacturing of structured and functional materials, membranes and particles on the basis of functional interfaces and micro and nano-scaled structures with defined, useful characteristics will take place.

Goals of such developments are, for example
- Materials that can be the basis for better components, for example for the process or pipeline industry, the automobile industry, or the bio or medical technology industry
- Technologies that enable technologically and economically viable solutions for the production and processing of micro and nano-strucuterd and/or functionalized materials, and
- Materials in which composites made from basic components PP, PA, PLA, PU, steel and nickel, and into which functional components (coatings or fillings) can be integrated (for example for the optimization of mechanical or tribological characteristics, catalytic effects, self-cleaning and healing, etc.)





Key Research Area "Vision Energy 21: On the Way to the Hydrogen Eonomy"

As part of the key research area Vision Energy 21, developmental work is to aid the future introduction of a renewable hydrogen economy. The vision of the key theme is to introduce hydrogen as a locally producible, storable, and efficiently distributable energy carrier. In this context, concepts and technologies for the production, storage and utilization of hydrogen from renewable energy sources are to be developed including interim solutions such as decentralized conversion technologies and concepts. The following aspects are of relevance:

- Hydrogen production and utilization
- Hydrogen distribution and storage
- Decentralized energy conversion on the basis of renewable energy sources
- Technological solutions and concepts for the introduction of the hydrogen economy (encompassing, for example, topics such as biogas-upgrading)



Key Research Area "Networks"

Modern business processes for production and for the provision of services are characterized by interoperative, integrated, and cooperative practices. The goal of the key research area Networks is the analysis, development, and optimization of these.

The focus is on the following strategies of modern production:

- Interoperative production: Increasing the efficiency and ergonomics of industrial processes by modeling and simulating interoperative processes while considering strategic goals and utilizing decentralized intelligence.
- Integrated production: Optimization of the value chain through the integration of primary and secondary production processes. Increasing the transparency, efficiency, and economics of production processes intra and interoperatively.
- Cooperative production: Improvement of the workflow quality between manufacturers, distributors, service providers through intermeshing services. Sustainable strategies to attain increased added value based on cooperation of systems and productions through clearly defined business processes and transparent, ergonomic interfaces

* The term biopolymer is defined as polymers that have monomers, which are totally or mainly contained in the biomass, or which can be made from biomass using bio-technological processes.

Six core competencies are the basis of our process technological work.
They find their application in the business units.

Core Competencies

- Process and application development
- Studies, expert opinions, surveys for decision-making processes (process engineering, market)
- Planning, construction, and operation of pilot and demonstration plants (PD plants)
- System analysis, system technology
- Software for process engineering
- Project development and financing



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Bioengineering
Synthesis of valuable material; reprocessing of biotechnological products; biogas production; biological wastewater, waste air, and solid waste treatment; enzymatic synthesis

Plastics Technology
Material development: polymers from renewable resources, biodegradable polymers, wood fiber reinforced compounds, recycling; customer specific special blends; compounding; material, production, and recycling-oriented design; injection or extrusion prototypes, small scale production; mechanical and rheological testing; thermochemical and spectroscopic analysis

Ressource-efficient Products
Biorefinery systems; market and technology studies; recycling concepts; product development

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Business Unit Process Technology
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Membrane Technology
Application and process development for membranes and microsieves; manufacturing and characterization of microsieves; process media cleaning; wastewater technology and water reutilization; specialty applications in the food, biotech, and metal processing industry

High-pressure Technology
Utilization of supercritical fluids for the extraction of contaminants and additives, impregnation and as reaction medium for chemical and enzymatic syntheses, decontamination of cultural treasures

Reaction Technology
Process development and optimization of multiphase processes in chemistry and biotechnology; process modeling and simulation; development and application of simulation and optimization software; CFD; process control safety equipment and pattern recognition



Business Unit Waste Management/-Technology and Adsorption

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Waste Disposal Management
Thermal treatment/energetic utilization; optimization of thermal processes e.g. through CFD; mechanical and biological waste treatment; mobile confectioning (treatment/sampling and initial analysis on site); production and utilization of refuse derived fuels (RDF)

Material Flow Management
Closing of material and energy loops; benchmarking of technical systems based on standardized numbers; simulation of waste treatment processes; generation of cost/benefit analyses for decision-making; ecological and economic optimization of disposal networks

Sorption Technology
Flue gas cleaning; gas washing and adsorption; gas cleaning for sewage treatment plants, landfills, digesters; conversion of gaseous airborne contaminants; development and characterization of high performance adsorbents in own tubular rotary kiln pilot plant stations; determination of material and process data for sorption processes; examination of activated carbon filters for motor vehicles; modeling of adsorption processes; recovery of solvents; air separation

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Business Unit Advanced Materials

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Dipl.-Ing. Jürgen Bertling
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Smart Materials
Thermophilic hydro gels; self-repairing sealing systems; immobilized catalytic converters; micro encapsulation with indicators, latent heat storage, etc.; micro hollow spheres for weight minimization; surface modified pigments; effect pigments

Particle Technology
Comminution (cryogenic/ambient); spray-drying, micro encapsulation; separation; rotating tube or fluidized bed technology; compounding; recycling

Analytics/Modeling
Modeling of particle formation processes and multi component material transport; model based process optimization and control; particle technology data processing and visualization; methods; CFD; population discrete elements method; artificial neural networks

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Business Unit Safety Engineering

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Fire and Explosion Protection
Fire and explosion protection; explosion protection documents; plant safety; fire safety concepts; smoke testing processes

Information Management
Electronic assistant systems; information management; document management; documentation of safety policies; state of the safety technology

Hydraulic Systems
Pipeline technology; pipeline test area; cavitation resistance; fittings and component testing; dynamic simulation of pipeline networks



Business Unit Energy Technology

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Gasification, Gas Upgrading
Gas capture and extraction (e.g. coal mine gas); gas treatment (adsorption, reforming); gas separation technology (oxygen enrichment, methane enrichment, CO_2-separation); low BTU gases (e.g. coal mine gas, landfill gas, biogas, gasification gas); emission trading consulting (inventory, project design document [PDD], trading)

Energy Process Engineering
Combustion, gasification (e.g. of wood, RDF, sewage sludge); fluidized bed technology, grate firing, burner technology, heat transfer; retrofit (e.g. efficiency increase, fuel switch, emission reduction); pollutant, hot gas, and tar analysis; system modeling and analysis; process control

CHP – Combined Heat and Power Generation
Regenerative fuels; fuel cell analysis (PEFC, MCFC, SOFC) and hydrogen technology; decentralized heat and power generation (co-generation plants, micro and mini turbines); supply and utilization concepts, economics

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Business Unit Energy Systems

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Energy Economics and Management
Energy analysis and operational optimization of heat, cold, and electricity supply systems; energy economy and politics; electricity and CO_2-trading; power plant application and resource optimization; risk management (deciding under uncertainty)

Sustainable Supply Systems
Application of combined heat, cold, and power plants; grid simulation and operational optimization; virtual power plants; leak detection with dissolved helium; generation of independent potential and feasibility studies incl. consulting

Cooling Technologies
Thermal cooling processes: steam jet ejector chiller, absorption chiller; solar thermal chiller: air conditioning, product cooling; application of high-performance refrigerants (PCS, ice-slurries) and latent heat storage media (PCM/PCS); innovative cooling processes; cleaning of combustion gases (landfill gas, sewage gas)



Business Unit Know-how and Technology Transfer

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International Projects
Organization, coordination, and execution of international joint research projects; organization of international research and development networks; consulting services for German and foreign ministries, municipalities and businesses; support for German companies with international acquisition and for foreign companies with activities in Germany; head office of the German-Polish research association INCREASE

Funding Programs
Identification of funding programs for internal and external customers; support in the application for national and international funds; organization of cooperation on a national and international level; adopting project management tasks

Technology Transfer
Project identification; execution of and assistance with project development; finding business partners (small and medium-sized enterprises, funding partners, technology promoters); point of contact for technology scouts; implementation of pilot and demonstration projects



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Innovation management; market and technology studies; project development; marketing concepts; sales; business area planning; strategy; intellectual property rights; press and public relations; composition and layout of printed media; media work; information medium internet



Occupational Safety and Environmental Protection
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Coordination and advice in topics related to occupational safety: vocational training and on-the-job courses; registration and notification procedures; monitoring of legislative regulations



IT-Management
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DP-auditing; planning, installation and operation of local networks; conception of central data management and security; data base development; developments of web applications; client server solutions; system architecture



Laboratory
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Dr. rer. nat. Ute Merrettig-Bruns
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Biotechnology; organic analysis, inorganic analysis; chemical-physical measurement methods; fuel characterization; refuse derived fuels; waste analysis; environmental chemistry; ashes, slag, compost, endocrine materials, landfill and biogas



Training-Center
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Knowledge and know-how transfer; interdisciplinary distance study program environmental sciences (infernum); practical training at schools and universities (TheoPrax®-communications center); practical training for private enterprises; blended learning; seminars; workshops; personnel development



Administration
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Personnel; projects; research contracts; budgeting; purchasing; accounting; business travel; infrastructure; controling



Central Technical Services
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Plant construction; project management; basic und detail engineering; sampling, analytical and pilot programs; technical service; central implementation of measurement and control, process control system implementation; operating technology center; mechanical and electronic workshops



Library
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Information management; literature and patent research

Plastics Pilot Plant

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Activated Carbon Pilot Plant

Branch Teterow
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With High Pressure Through Life
Interview with Prof. Dr.-Ing. Eckhard Weidner

1. You have now been in your new position for 80 days. According to the famous novel by Jules Verne, that was enough time to travel around the world once in the 19th century. What is it like today? How have you used your time?

I have used the time to familiarize myself with the small world of UMSICHT, which is not so small after all when you explore it from the inside. One of my main tasks was to get to know the employees of the institute.
I also used the time to become acquainted with the sizable Fraunhofer family.

2. What is your impression of your new team?

The different teams have a very professional demeanor and exhibit a great deal of enthusiasm for the topics at UMSICHT, namely Environmental, Safety, and Energy Technology.
They are highly motivated in driving the research and development work forward.

3. Where do you see the particular R&D strengths of the institute and what is in store for the future?

Well, I see the strengths in our concentration on the four key research areas, which were developed under my predecessor, Professor Kümmel. The focus of the **"Vision Energy 21"** is the expansion of future oriented energy technologies such as the hydrogen economy. The keyword **"Networks**" denotes, among others, the integration of software into production and safety processes. One of the focus areas we are currently expanding into a broader research topic is **"Biorefinery"**, which is about renewable resources, regenerative energies and material utilization. Under the motto **"MatFunc"**, we dedicate ourselves to the development of functional materials, membranes and particles.
Note from the editors: (More on this topic on page 12)

4. How are you planning on advancing these very different and complex areas?

First, we need to develop our strengths. We want to show what UMSICHT is capable of and where UMSICHT has unique selling points. We have to sharpen our profile so that potential industrial partners and funding agencies know exactly in which areas UMSICHT is one of the first addresses. How are we planning on doing that? We will use our investment resources primarily to build research efforts around our key research areas with which UMSICHT will establish itself as a very strong member of the German and European research landscape in the medium and long term. The institute management and employees are currently starting the process of outlining which detailed programs that will be specifically.

5. You are working in the area of high pressure technology. Please briefly describe what you are currently working on.

The transfer of physical-technical and physical-chemical fundamentals into technical processes is what primarily drives me. A very active area of research is the production of particle systems with very specific characteristics. The spectrum of applications ranges from chocolate powders that incorporate liquid aromas that offer a unique taste experience to powder glues that can enable a solvent-free and, thus, an environmentally friendly way to fasten to pharmaceuticals that release their active ingredients very quickly or slowly. It is exciting to develop products that all of us want to have and to find the technical solutions and methods for that. I am particularly delighted that the research areas in Bochum complement the ones in Oberhausen very well, creating an extraordinary research synergy. In Bochum, we are focusing on high pressure technologies and organic products. In Oberhausen, the focus is on normal pressure technologies and inorganic products. Therefore, we can offer our partners a uniquely wide service spectrum.

6. You were born in Stuttgart, lived and worked in Erlangen for a long time, until you moved to the Ruhr area in 1998. What do you think about the Ruhr area?

Extremely exciting. It was a challenge to move here with the opinion people from the south have of the Ruhr area. However, my wife and I became fans of the Ruhr area from the first day on. It is an area that has been going through a significant transition during which it has developed its own charm. Certainly, we cannot compete with other areas of Europe in terms of nature, but, in terms of culture and industrial landscape, this is a unique and attractive place. We always advertise with our relatives and friends to spend a few days or even weeks in the Ruhr area to get to know it. Another impression I have received over the last six years is that the people here are very open and friendly. It is easy to get to know people and make social and personal contacts.



Prof. Dr.-Ing. Eckhard Weidner (born 1956) has been head of the Fraunhofer Institute for Environmental, Safety, and Energy Technology since November 1st, 2004.

After receiving his University degree, working in the industry, and receiving his PhD, Weidner was promoted to be a professor at the Friedrich-Alexander University in Erlangen in the Chemical Engineering department and worked in the promising area of micro and nano technology.

In 1998, he was offered the chair of process technology. In addition to an impressive scientific career, the process engineer always found time for ventures into industry.

Prof. Weidner's key competencies are in the areas of high pressure and particle technology as well as in the areas of natural materials and polymers.

7. Since November 1st, your calendar has been fuller than ever. How do you spend your valuable free time?

I like to read a lot. I just finished "A short history of nearly everything"*, a very concise summary of the history of science. The book gives a nice overview and is a very amusing read.

Then I also have an interest in craft projects at home. Twice a week, I also try to work out. I play either squash or badminton, and then I do some back exercises, which is also necessary as one gets older (laughs). After all, one has to stay fit a little bit.

8. If you had one wish, what would it be?

I can't answer that very easily. Of course I wish for my family and staff members to be healthy. For UMSICHT, I wish for all of us to master the exciting and surely challenging next two years ahead and to come out of them stronger.

*Bill Bryson, A short history of nearly everything, Random House

R&D-Services

infernum and TheoPrax®

Chemistry and Anlaytics

Biotechnological Laboratory

Marketing, Communication, Business Development

IT Management

Central Technical Facilities

Library













Successful research and development needs good service and proper management – external as well as internal! Therefore we provide the allround service our business units profit from to our customers as well.

infernum

In collaboration with the FernUniversität (Open University) in Hagen, Fraunhofer UMSICHT has been offering an interdisciplinary distance learning degree for environmental sciences since November 2000. The goal of the four-semester continuing education degree is to provide up-to-date, practical, and comprehensive environmental know-how to students both in their own and related disciplines and is specifically designed for engineering, science as well as law and humanitarian students. This imparts the students with the interdisciplinary skills, which are necessary for solving complex environmental problems.

In October 2003, infernum was granted accreditation to confer the degree of "Master of Environmental Sciences", making it the only the distance learning master degree in the field of environmental studies available in Germany to date. The seal for outstanding quality in its field for the innovative continuing education degree was awarded by the renowned "Agentur für Qualitätssicherung durch Akkreditierung von Studiengängen AQAS" (= Ageny for Quality Assurance by Accreditation of Study Courses).

infernum has encountered widespread interest and acceptance even beyond the borders of Germany, for instance from Austria, Switzerland, the U.S., China and South Africa. Enrolled students come from a variety of backgrounds such as engineering, sciences, business, medicine, theology, and education.

Workshops regularly conducted in Oberhausen and other German cities help students get to know teaching staff and fellow students while expanding on the obtained knowledge with technical lectures and learning how to work in interdisciplinary teams.

The Hochschulgesellschaft Oberhausen e. V. regularly awards scholarships to "infernum". The scholarship recipients are characterized by high scientific qualifications and a special personal and professional commitment to environmental protection. The innovative educational model represents a significant building block of the science-region Oberhausen and should help increase its attraction.

TheoPrax®

The educational model TheoPrax® is a practical experience and systems oriented approach that aims to combine theory and practice early on. Initiated by the Fraunhofer Institute for Chemical Technology ICT (Pfinztal), TheoPrax® has been successfully applied in Baden-Württemberg since 1998. As part of a nation-wide expansion, a TheoPrax® communications center was established at Fraunhofer UMSICHT in order to introduce the educational model in the Rhine-Ruhr region.

How does TheoPrax® work?

Firms contact Fraunhofer UMSICHT with industrial problems. Acting as the regional communication center, Fraunhofer UMSICHT then forwards the problems to schools and universities, where students form groups to solve the problems.

What are the benefits of TheoPrax®?

TheoPrax® gives students an opportunity to get an early insight into the professional world, which helps them develop key skills such as creativity, conflict resolution, communication, and team work. Employers can recruit young talents that are aware of what it takes in business. They can also present their company's profile to the potential employees in the context of the project work. Therefore, TheoPrax® represents an ideal platform for the development and acquisition of the future workforce.

Your contact
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Chemistry and Analytics

Precise and reliable analytics are a precondition for the solution of environment-chemical questions. Scientists and technical staff work together in the highly qualified and experienced team "Chemistry and Analytics" to complete this task.
For this purpose, laboratories with an extensive instrumental equipment, among others state-of-the-art analytical system combinations, are available at the institute.

The wide spectrum of services offered particularly contains the development of innovative, custom-made methods, currently for example

- ultra trace analysis of pharmaceuticals and endocrine matters in wastewater,
- characterization of secondary fuels,
- plastics analysis and
- biocide determination in art treasures made from wood as well as
- measuring of siloxanes in landfill gases.

The validation of measurement results is carried out among others by comparison with external laboratories (interlaboratory tests).

We further focus on the optimization of technical processes for qualitative improvement of products (ash, slag).

Our team offers analytical solutions, consulting services in the planning of examinations, and helps evaluating your analytical results.



Chemistry and Analytics





Biotechnological Laboratory

Biotechnological Laboratory

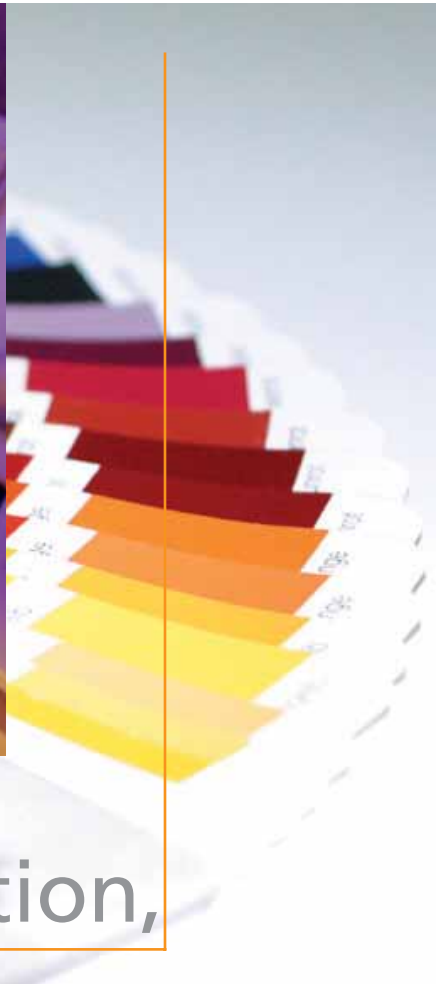
The biotechnological laboratory handles tasks on the cleaning of polluted media (water, soil, air), examines biological decomposition and production potentials, and develops novel microbiological processes from laboratory to pilot plant scale.

New biotechnological processes and plants are planned step by step, designed and examined to ensure technological feasibility at a high level of efficiency and operational safety. The biotechnological laboratory can realize creative and efficient solutions by cooperating with engineers and natural scientists of the analytics and the engineering departments.

As an approved testing laboratory of "Bundesgütegemeinschaft Kompost e. V." (Federal association of compost quality standards), and approved testing laboratory of DIN CERTCO for testing of composting capability of materials according to DIN V 54900-1 to -3, ISO 13432, ASTM 6400 we offer:

- microbiological analyses according to DIN, ISO, OECD-processes
- testing of biodegradability under aerobic and anaerobic conditions (e.g. AT_4 and GB_{21} according to "Abfallablagerungsverordnung" [Regulations concerning waste disposal])
- Development of biotechnological production processes





Marketing, Communication, Business Development

Marketing, Communication, Business Development

The marketing of products and services, analyzing, and handling of business sectors, developing new market strategies, and finally representing the institute in public are the tasks of the department of "Marketing, Communication and Business Development". Being directly responsible to the directorate, we support the scientific staff in the positioning of new products and fields and in tailoring them to the customer's requirements. Market surveys and technology studies help to assess opportunities and risks of new developments at an early stage.

Developing and preparing the institute's public relation materials and web appearance is among our strengths. Our web news regularly and readily keep editors and journalists updated about the latest research results at Fraunhofer UMSICHT.
To protect new developments from plagiarism, our department is also responsible for the registration of inventions, assistance in intellectual property rights, and in license agreements.

Innovation management and marketing are more than void phrases for us:
our services encompass guided brainstorming, market surveys, business sector analyses and strategies, market introduction of products, marketing concepts and industrial property rights policies as well as public relation concepts, particularly offered to small and medium-sized enterprises.
We want projects with Fraunhofer UMSICHT to be attractive, successful, and reliable projects – for our customers and together with our customers!

IT Management

An efficient and reliable information and communication technology service is an indispensable prerequisite for any efficient project work. The IT management provides internal and external services, focusing on the following areas of expertise:

- planning, continuous operation and support of the DP infrastructure
- provision and update of software packages
- assistance in IT-specific problems
- provision of IT systems to support the work flow

A powerful server network equipped with a gigabit backbone is available for the efficient use of resources such as computer servers or data bases.

The system comprises highly available file servers with capacities in the terra-byte range including adequate band security, as well as intranet services, which are of increasing importance.

The IT management also offers services to external customers, in particular to small and medium-sized enterprises, including:

- DP-auditing
- planning, installation, and operation of local networks
- applications development concepts of central data management and storage
- development of system solutions

The department currently employs trainees who are becoming IT-specialists in the field of system integration and applications development.



IT Management

Central Technical Facilities



Central Technical Facilities

The cycle times of technological innovations are minimizing rapidly in industrial and process engineering.
In order to secure a technological headstart and not only keep pace with others, a smooth and prompt realization most be guaranteed.
The central technical facilities realize technological know-how for internal and external costumers quickly and competently.

Specialized on the sector of test, pilot and demonstration plants our strenghts lie in:

- basic and detail engineering
- implementation of process control systems and
- measurement, control technology and control engineering.

Technical service is the basis of our work. Our team, consisting of electricians, mechanics and engineers, accompanies you the whole way: starting with the consultation, over planning and construction to the final production of your plant, we try to find the best solutions together with you.
Among other things our repertoire comprises the made-to-order production of special components and the production of ready-to-operate technical plants.

We invest in the future by handing our know-how down to the succeeding generation. Trainees in different fields set out on their way into the future in our facilities.

Library – Specialist Information Service

"Knowledge" has long since become an economic factor securing technological advantages of a location. For keeping the scientific-technical qualification of our staff always highly up to date, the scientific specialist library provides literature on the UMSICHT-specific topics environment, energy, safety, and process technology as well as knowledge and technology transfer.
At present our stock comprehends approximately

- 7 000 monographs
- 60 subscriptions to scientific journals
- 38 permanently updated loose-leaf-collections
- 20 information services (among others publication series of ministries organizations, and institutions)
- bulletins issued by government boards in various research disciplines

The Library

- supports scientific personnel in obtaining specialist information in the Internet via an own Intranet-homepage serving as specialist portal,
- carries out literature and patent researches,
- trains staff in researching in end user services provided,
- documents own publications for the world wide accessible database Fraunhofer Publica and
- is in charge of UMSICHT publications (conference transcripts, dissertations etc.) from advisory support the author to the delivery of the printed copy to the "Technische Informationsbibliothek" (TIB, Technical Information Library) in Hanover.



"An enormous reservoir of raw materials grows in nature every day. Let the diversity inspire us to think of and develop new products beyond crude oil."

[Dr.-Ing. Stephan Kabasci, Business Unit Manager Renewable Resources]



We develop and optimize technological processes for the extraction of valuable substances and the generation of energy from renewable resources and residuals. Our strengths lie in the application of biotechnological processes and in plastics technology.

Business Unit Renewable Resources

Monitoring and Control of Anaerobic Plants

Enzyme Catalysis in Supercritical Fluids

Corn Starch Tray

Biodegradable Adhesive Tape

Business Unit Process Technology

Business Unit Waste Management/-Technology and Adsorption

Business Unit Advanced Materials

Business Unit Safety Engineering

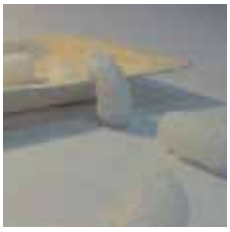
Business Unit Energy Technology

Business Unit Energy Systems

Business Unit Know-how and Technology Transfer

Names, Data, Events







Monitoring and Control of Anaerobic Plants



Everything is ok in the fermenter – thanks to a new monitoring and control technology

Development of a System to Monitor and Control Biogas Production Plants

The utilization of renewable resources to produce electric power und heat represents an important step in the development of sustainable energy supply systems, which help conserve fossil fuels and reduce the emission of greenhouse gases. In order to establish environmentally friendly plants for energy production on the market successfully, they have to be highly efficient and reliable.



This project, funded by the "Zukunftswettbewerb Ruhrgebiet", aims to develop an innovative control and monitoring system to ensure save operation of biogas production plants and anaerobic wastewater treatment plants, while at the same time increasing performance.

The anaerobic conversion of organic matter to methane is a very complex multi-phase process involving multiple microorganisms. It can only proceed without disturbance when a dynamic equilibrium is established.

Although it is possible – taking into account certain presumptions – to define a system of equations describing each stage of the process, the development of a mathematical model for this complex process in its entirety is practically unfeasible.

As part of this project, a newly developed, cost-competitive and reliable analysis tool for the online-measurement of the biogas composition will be used for the monitoring of biogas at two pilot-plants.
One of these plants will be used for fermentation of organic matter with a high solids content, the other for the treatment of brewery wastewater.
The measurements taken at these plants will give us a clearer understanding of the ongoing processes in the biogas production plants.
Based on the data collected from this research project, a reliable methodology for the analysis, control and optimization of the anaerobic methanogenesis will be developed.

The project is funded by the "Zukunftswettbewerb Ruhrgebiet"
- ENR – Energiegesellschaft nachwachsender Rohstoffe mbH
- CHEMEC – Ingenieurbüro für Chemo-Messtechnik GmbH
- Privatbrauerei Moritz Fiege GmbH & Co KG

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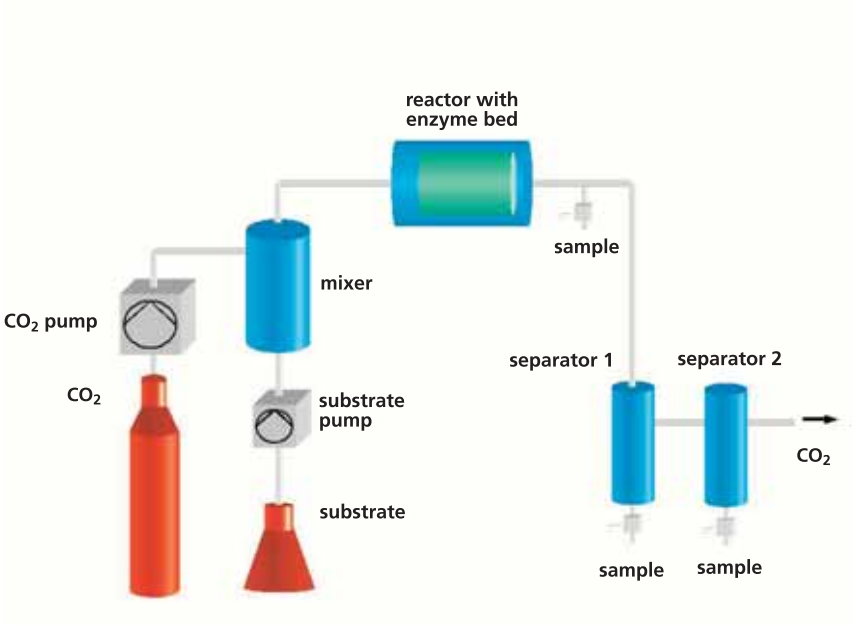
*lat. determinare – to determine
A procedure is deterministic when at any time during the process it is determined how the process will go on.

Carbon Dioxide Replaces Organic Solvents

Biotechnological processes such as enzyme catalysis are becoming increasingly prevalent in industrial production. The goal of current research efforts is to develop environmentally friendly processes, which, at the same time, help reduce production costs through process simplification, raw material costs, and generation of byproducts and waste components.

Using enzymes in supercritical fluids represents an emerging field of research. It enables synthesis and product treatment processing components with poor water solubilities, eliminating the need for additional organic solvents.
Of particular economic interest is the production of fine chemicals, especially of enantiopure substances for pharmaceutical applications and of flavor and fragrance compounds for the food and cosmetics industries, where high purity is essential.

Within a joint project, the influence of different process parameters (pressure, temperature, residence time etc.) on enzymatic reactions in supercritical carbon dioxide is under investigation. An immobilized lipase is used as catalyst. The goal of the project is the development of a mathematical model to describe the complete process for scale-up calculations. Thus, an important tool for transfering the process to additional reaction systems is provided.



Scheme of the enzymatic catalysis that does without solvents

A continuous high pressure lab-scale plant allows for investigation of the reaction kinetics up to a pressure of 140 bar. Knowledge about the phase equilibria between carbon dioxide and the reactants is of fundamental importance for the product treatment.
A lab-scale plant was designed and built for the experimental determination of the phase equilibria. Additionally, a high pressure pilot plant can be used for the production of sample products.

Partners of the projects:
- University of Cologne, Institute for Physical Chemistry
- University of Rostock, Department of Chemistry

Your contact

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* Supercritical Fluids = at pressures and temperatures which are above the characteristic critical value of each substance pure substances turn into supercritical fluids which show characteristics of its liquid as well as gaseous state.

** AiF = German Federation of Industrial Cooperative Research Associations

Corn Starch Tray

Surely soon freezers can no longer be imagined without them: Film laminated packaging trays with a carrier based on foamed starch



In Good Shape – Molded Parts Based on Corn Starch Foam

Products based on renewable raw materials save resources of fossil energy sources, are compostable and reduce the emission of CO_2 into the atmosphere. These products are used especially in the area of packaging and catering because of the short product lifecycle and their very good environmental compatibility.

Starch and modified starch are used preferentially in biodegradable products since they are available almost everywhere and in addition they are low-priced and the macromolecules can be produced easily directly from agricultural products.

Together with the Hubert Loick Group the idea of a continuous production of packaging trays based on starch for catering and food packaging is pursued. Target of the development is the reduction of production costs compared to conventional discontinuous baking processes and to keep up technologically with materials from petroleum-based expanded polystyrene (EPS).

Within extensive R&D work in extrusion and die technology, plant construction and material development at first a foamed flat section was extruded. After optimizing flow properties and foam structure of the extrudate first packaging trays were formed in a deep drawing process. Their contact properties to food were further improved by inline film laminating. A technical-economical benchmarking of different processing types, their implementation and testing on pilot plants and modified production lines followed. The packaging trays produced as samples fulfil all technological requirements.

The project results offer the necessary technical and economical basic data to implement a continuous tray production in an industrial process. Furthermore, new information about material and processing properties of starch formulations could be gathered.

Your contact

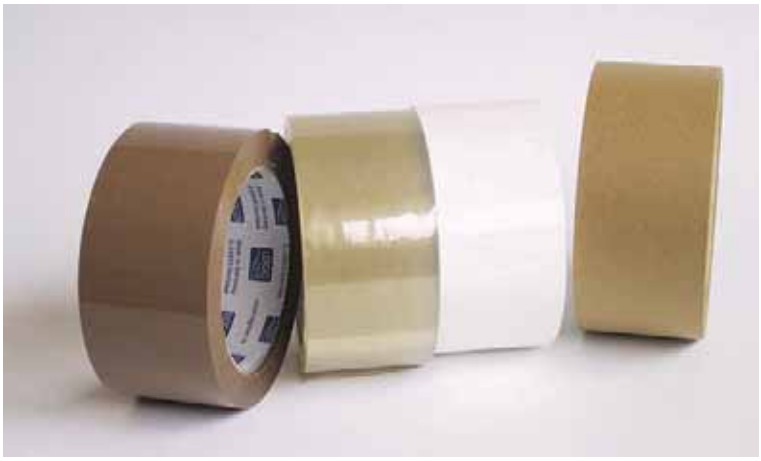
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(+49 2 08/85 98 -12 65)

Development of a 100 % Biodegradable Adhesive Tape

Materials based on renewable resources are increasingly gaining in market shares. Growing environmental awareness in combination with a shortage in fossil resources and the resultant cost increases for crude oil products support this development.

A research project by Fraunhofer UMSICHT and the Logo tape Gesellschaft für Selbstklebebänder mbH & Co. KG focuses on the development of a self-adhesive tape based on renewable resources. Ideally, the carrier film as well as the adhesive for the tape are to be compostable according to DIN EN 13432. The characteristics profile of the product under development with regard to mechanical properties, initial adhesive strength, inner strength, storage time and printability is defined by conventional self-adhesive tapes and shall be accomplished without compromise. The challenge lies in the conflict of achieving compostability while meeting the demanded properties for the product life.

The main focus of the research of Fraunhofer UMSICHT in this project is on the material development for the carrier film and adhesive, production of small series of the developed materials for processing tests and also on carrying out tests at film manufacturers and Logo tape. In the first project phase, a compostable compound based on natural resources is developed, which is required for film production.The polymer polylactid acid (PLA) for this compound is produced by a combined biotechnological and chemical process from starch containing plant substrate such as corn as suitable matrix material.



The 100 % biodegradable adhesive tapes will be just as good as the currently offered adhesive tapes.

The material will be modified systematically using additives corresponding to the desired characteristics profile. At the end of this phase, a film is extruded from the new compound, which is needed for production of adhesive tapes and non-stick films. During this phase, existing processing technologies are adapted to the new compound. At the same time, a suitable compostable adhesive for the coating of the film is developed, which fulfils the demands on adhesive tapes and labels.

The first phase of material development for the carrier film has already been completed. A comparison of the mechanical properties of films based on the new compound with conventional adhesive tapes shows that the demanded characteristics have been achieved.

Your contact

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(+49 2 08/85 98 -12 65)
Dipl.-Ing. Anneliese Kesselring
(+49 21 54/92 51 -24)

The processibility of the carrier film is tested on conventional cast film lines.



"Process technology means to view the process chain as a whole. Modeling, simulation, and demonstration plants are our tools. That is how theory is turned into tangible practice."

[Dr.-Ing. Görge Deerberg, Business Unit Manager Process Technology]



We develop and realize system solutions for process technology based on demonstration plants in the laboratory or workshop as well as on model-based simulation software. Our strengths lie in the membrane, high pressure, and reactor technology.

The Institute

Business Unit Renewable Resources

Business Unit Process Technology

Biocatalysts in Stirred Tank Reactors

Forming of Glass

Phase Equilibria in Supercritical Carbon Dioxide

Wastewater Technology in Latin America

Business Unit Waste Management/-Technology and Adsorption

Business Unit Advanced Materials

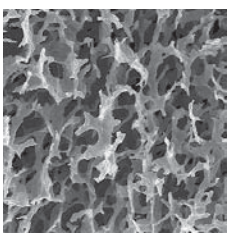
Business Unit Safety Engineering

Business Unit Energy Technology

Business Unit Energy Systems

Business Unit Know-how and Technology Transfer

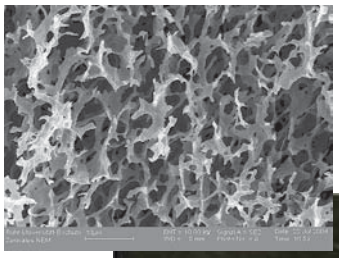
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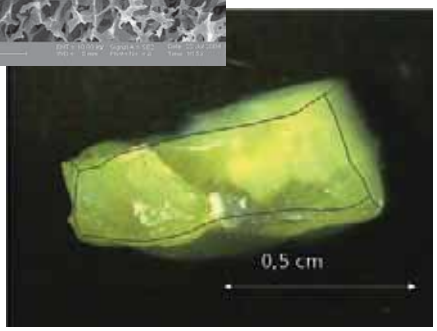




Biocatalysts in Stirred Tank Reactors



Scanning electron microscope photography of the freeze-dried hydrogel



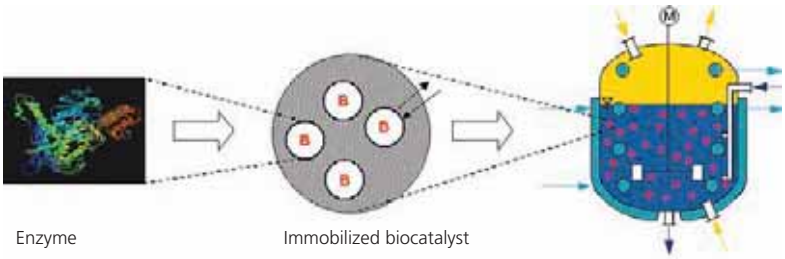
Slize through the hydrogel after loading with a reference substance

Temporarily in Touch: Biocatalyst and Hydrogel

The use of technical enzymes for the synthesis of fine chemicals and pharmaceuticals is gaining more and more importance, particularly regarding the production of stereospecific substances.

These compounds take a key position in the pharmaceutical and chemical industry as intermediate and final products. Stereoselective synthesis of fine chemicals, pharmaceuticals and agrochemicals exhibit a high economic potential.

Enzymes can catalyze various chemical reactions with a high degree of selectivity. Hence, they are becoming increasingly important for production processes. The use of biocatalysts has a special relevance for the chemical and pharmaceutical industry due to different advantages. In particular, biocatalysts have a high substrate and product-selectivity. They may hold significant advantages compared to process alternatives employing conventional procedures for the synthesis of high-quality products, particularly for small and medium-sized enterprises (SME).



Enzyme | Immobilized biocatalyst | Stirred tank reactor

Modeling

Beyond that, the use of biocatalysts offers alternatives to harmful and energy-intensive chemical processes. In addition, biocatalysts deliver substantial contributions to production-integrated environmental protection. Energy and raw material input can be reduced in catalyzed reactions due to catalyst characteristics, selectivity and reduction of the activation energy. Formation of unwanted by-products, emissions and waste materials can be lowered.

The main goal of the AiF*-research-project is the development and validation of a process for the production of stereospecific, poorly water soluble compounds in organic solvents using immobilized biocatalysts in standard stirred tank reactors. The key component within the project is the implementation of a temperature sensitive hydrogel as reversible immobilization matrix which allows the sequential loading, repetitive use and unloading of the hydrogel. Additionally, the development of a software tool is planned, which can be used by SME for projecting new plants or for the optimization of existing plants.

* AiF = German Federation of Industrial Cooperative Research Associations

Your contact

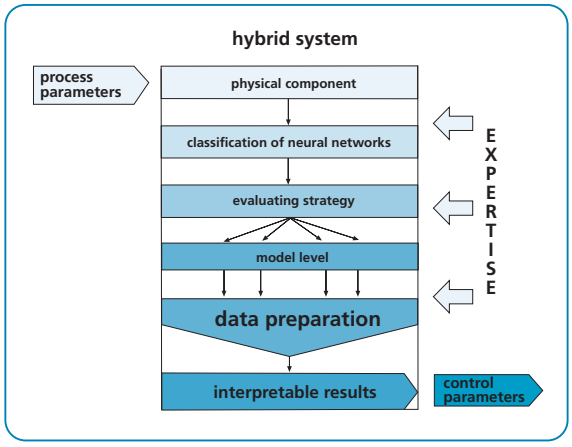
Dipl.-Ing. Hans-Jürgen Körner (+49 2 08/85 98 -12 72)

Manufacturing Systematic

Subject of the investigations is a plant for the production of bent glass. The essential components of this plant are a kiln and a bending tool. In the kiln, glass plates are heated up to a temperature of approx. 700 °C prior to being transported into the bending tool where it is bent into the desired shape. A special feature of this plant is the reproducible manufacturing of large-size bent glass plates.

The glass forming process is characterized by interactions of the control parameters (control values of the plant, glass properties and ambience conditions) and the final product characteristics (quality, geometry, safety). A physical relationship does not exist and/or has not been sufficiently investigated yet. At present, the setting of the plant control parameters is done via the trial-and-error method. However, this relationship has to be established for an economic production of small quantities of new glass-products with large dimensions and different bending radii.

The main goal of this project is the development of a hybrid system as a decision-support-tool for the operator with regard to choosing the right control values. On the model level, this system consists of several components (physical models and neural network models), which are related to each other based on available expertise. Experiences from chemical engineering show that the combination of physical models and neural networks will lead to an improvement concerning the theoretical description of the regarded process. In addition to the models, a separate component for the interpretation and transformation of the results into the control values of the plant will be developed.



Hybrid system as a decision-support-tool for the operator

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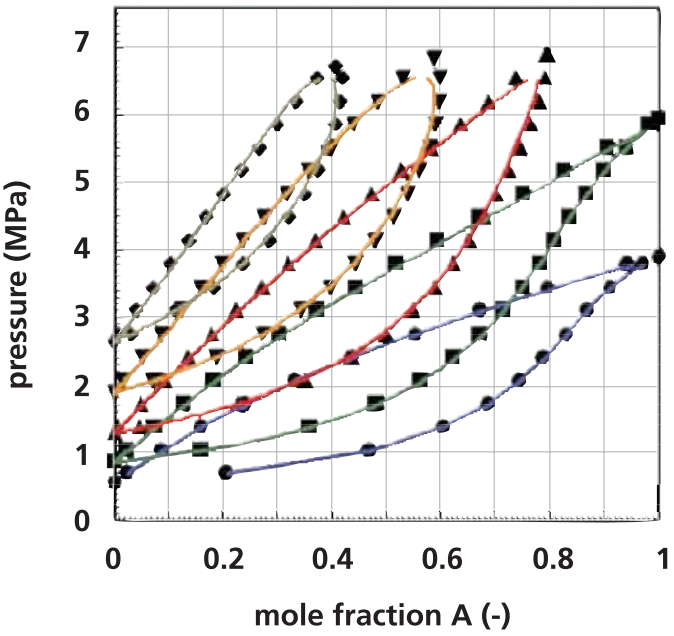
Phase Equilibria in Supercritical Carbon Dioxide

Phase Equilibria in Supercritical Carbon Dioxide

The measurement of phase equilibria helps make predictions about the separability of certain components or groups of substances. Furthermore, an analysis regarding the choice of appropriate operating parameters for the fractionation can be carried out based on these data. The selective separation by fractionation is of interest when a product mixture has to be separated continuously. In the case of supercritical carbon dioxide, the fractionation can be achieved by using two or more precipators with different pressure steps.

Fraunhofer UMSICHT conducted investigations on enzyme-catalyzed esterification in supercritical carbon dioxide (see page 31). These investigations were funded by the German Federation of Industrial Cooperative Research Associations "Otto von Guericke" (Arbeitsgemeinschaft industrieller Forschungsvereinigungen "Otto von Guericke" e. V.). The measurement of phase equilibria is necessary for the mathematical modeling of the physical process. Furthermore, the measurements are required for validation and extrapolation of the applied model.

The apparatus used for practical examinations allows the determination of solubilities and phase equilibria in the range of up to 45 MPa and 100 °C. The main component of the apparatus is a view-cell with a movable piston for keeping the pressure constant. The maximum volume of the cell is 63 cm³. The tests were carried out using the static-analytical-method, determining the chemical composition of liquid and gas phase samples by chemical analysis.



Supercritical phase equilibria

For a binary model system a good correlation of chemical analysis with literature data was achieved. Further investigations will focus on additional binary and quintuple systems, the latter being important for the esterification.

The apparatus can be used for different tests within the scope of the described experimental parameters and is available for future investigations.

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Interactive Platform for German Water and Wastewater Technology in Latin America

www.aqua-latina.info

Diseases passed on by water, water contamination and water shortage have been recognized as primary global problems. By consolidating and strengthening existing skills and capacities the German water and waste-water economy can now contribute in a more target-oriented way to the improvement of the water situation in several regions.

This bundling is to be achieved by the creation of an interactive Internet platform, which is not only presenting general technical information of enterprises, but in fact calculation and evaluation routines for the planning of decentralized local-specific water supply and wastewater disposal. "www.aqua-latina.info" represents an innovative platform for the establishment of integrated water management concepts into and for Latin America under the participation of German SMEs.

In the first project phase concepts for the integrated decentralized water management in Latin American municipalities are developed and necessary technologies are characterized and taken stock of. Besides an Internet-supported planning-tool for the technology selection will be devised.

The first part of the Internet platform of "www.aqua-latina.info" and the planning-tool itself have already been developed. This tool has been realized in a modern graphically supported program development environment of the fifth generation where graph-based decision structures are transfered into interactive "clickable charts". Characteristic for these charts is the logging of the decision ways and producing of context depending results using hypertexts. The converted "charts" are to be used by the user directly. On the basis of these context sensitive decision flow charts circumstances can be examined, information can be collected and help functions, texts and results can be called up as well. The result is generated during run-time through the decision structures based on data supplied by the user. At any time results limited on the present intermediate result, as well as in its total version can be chosen.



www.aqua-latina.info informs about water and wastewater technologies Latin America in German, Portuguese, and Spanish.

In a second project phase which is intended to start in the middle of 2005 the individual adaptation and the selective technological modification and the new development respectively as well as the realization of partial components by the example of two specific municipalities in Latin America will be carried out.

"www.aqua-latina.info" informs on water and wastewater technologies in Latin America in Portuguese, Spanish and German.

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"To think in loops is easy. To realize loops is much more challenging. Feasible material flow management protects the future in the long run."

[Dr. rer. nat. Kai Keldenich, Business Unit Manager Waste Management/-Technology and Adsorption]



We manage material flows, develop sorption technology concepts for the cleaning and upgrading of gas and offer concepts for the incineration and treatment of heterogeneous material flows in the field of disposal technology.

The Institute

Business Unit Renewable Resources

Business Unit Process Technology

Business Unit Waste Management/ -Technology and Adsorption

Decentralizes Combustion Plant MARS®

Activated Carbon Technology

Benchmarking of Waste Incineration Plants

GREASOLINE®

Business Unit Advanced Materials

Business Unit Safety Engineering

Business Unit Energy Technology

Business Unit Energy Systems

Business Unit Know-how and Technology Transfer

Names, Data, Events







Decentralizes Combustion Plant MARS®

Continuous Operation of the MARS® Plant

The modular incineration plant with reduced flue gas cleaning residues (MARS®) is a pilot plant located in Essen at the University of Duisburg-Essen. The plant is operated by the Fraunhofer Institute UMSICHT and the Chair of Environmental Process Engineering and Plant Design of the University of Duisburg-Essen. The plant is equipped with a water cooled grate system and offers the possibility of measuring and collecting (flue gas) samples at various locations. Therefore, the plant is the optimal research installation and can be operated with "problematic" materials (e. g. with high calorific values).

MARS® will be expanded by fitting it with a boiler for energy recovery in addition to flue gas cleaning units complemented by a "selective non-catalytic catalyst reduction" (SNCR). The SNCR will ensure compliance with emission limits while burning materials rich in nitrogen.

The MARS® plant can be operated with different fuels. Fraunhofer UMSICHT develops innovative processes to characterize these fuels. One process, for instance, deals with the release of volatile components on the grate.

Another expansion of MARS® will be a new transport system delivering the fuels into the hopper. The system has to comply with hygienic, technical and safety standards, while ensuring a good mixture of different fuels and an automatic operation of the plant.

In 2004, the MARS® plant was used to examine the incineration of fuels such as biomass and trade and commercial waste. Complex analyses of flue gases, ashes and fuels were carried out. The results were interpreted and provided to the customers.

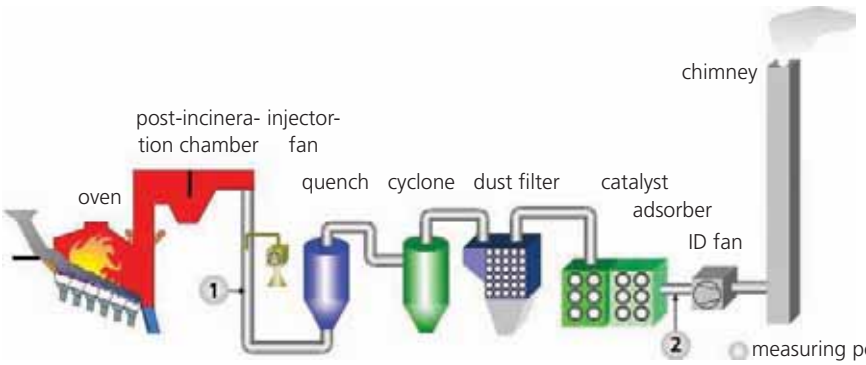
In 2005, the MARS® plant will be used for further experiments using other fuels. The Hytim® – camera (see picture on the right hand side) will be used to observe the combustion behavior in the combustion chamber.

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View into the combustion chamber with the help of the Hytim® Camera



Schematic diagram of the MARS® plant

Novel Activated Carbon Monoliths from Renewable Resources

Fossil carbon sources are the basic raw material for many industrial synthesis processes. A recent trend in process technology has been their substitution with renewable resources as a viable alternative. Herbal products are highly appropriate for the production carbonaceous adsorbents due to their unique chemical (and partly physical) structure.

A demonstration project in this field is carried out at Fraunhofer UMSICHT's Teterow branch, funded by the Ministry of Economics of Mecklenburg-Western Pomerania with budgets of the European Regional Development Fund (ERDF).

As part of the project, activated carbon monoliths are produced using precursors and co-products from sugar production as binding agents. They are mixed with activated carbon powder, pressed into their monolithic shape, dried and hardened. The activated carbon powder used in this process is also made from renewable resources. The activated carbon can be shaped to meet the geometrical requirements associated with specific applications.

Conventionally, adsorbent monoliths are produced by fixing an adsorbent precursor to a matrix structure and subsequently hardening and activating the whole structure. In this case, the matrix usually takes up much of the monolith's volume without significantly contributing to the adsorption capacity or even the accessible pore volume. One of the most important advantages of the sugar-related binding agents arises from their carbonization during the hardening process. Releasing volatile components, they develop a pore structure on their own, thus granting the molecules to be adsorbed access to activated carbon particles inside of the monolith's structure.





Ø 6 cm (2,36 inch), height 6 cm (2,36 inch) activated carbon monolith without supporting structure: boil proof and heat resistant up to 400 °C (752 °F).

Among other applications, the produced activated carbon monoliths can serve as police filters/ safety filters in automotive fuel systems, as compressed air filters, or to reduce the ozone emission of photocopiers. Compared to bulk activated carbon, the monolith's advantages are: easier handling, near-zero dust emissions and – in case of trans-matrix flux – improved mechanical filtering results.

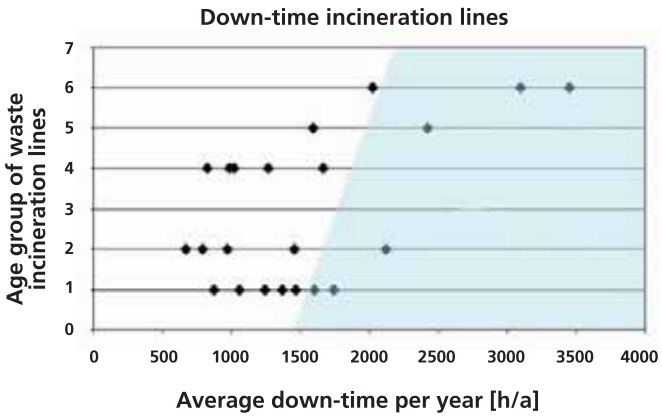
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Benchmarking of Waste Incineration Plants



The bird's eye view shows the impressive dimensions of the SEMASS plant



The graph shows the average down-time of the incineration lines depending on the age of the lines. The age of the lines is summarized in age groups.

Waste Incineration – at its Optimum

The cost pressure in the waste management sector is greater than ever due to competitive waste treatment technologies on the market. As a result, operators of existing waste incineration plants are very interested in a continuous improvement of the plant processes. The use of standardized indicators is one method to determine and identify sustainable improvement potential. It is therefore necessary to collect and standardize technical, economic and ecological data. These standardized indicators allow for the comparison of plant components (such as energy recovery and bottom ash treatment). The indicators are based on waste amounts, energy (energy per ton of waste) or costs (cost of maintenance per ton of waste).

On behalf of the Japanese company NEECO, a licensed supplier of "SEMASS" waste incineration plants, Fraunhofer UMSICHT investigated the SEMASS plant in the US state of Massachusetts to examine the advantages and disadvantages of this technology. Fraunhofer UMSICHT collected and evaluated data such as material and energy flows, combustion, flue gas cleaning, emissions, repairs, down-times and costs. One indicator, for example, describes the down-time of the incineration lines depending on the age of the lines. The indicators were standardized and compared to other European incineration plants.

In contrast to most German plants, the SEMASS plant, operated by American Ref-Fuel, has a complex mechanical pre-treatment for the incoming waste. The pre-treatment includes size reduction of the waste accomplished via hammer mills and via the removal of metals. Belt conveyers are used to transport the treated waste into the combustion chamber. The waste is blown into the chamber.
The business unit Waste Management/-Technology and Adsorption is planning to use standardized indicators in other waste management sectors. One main focus of the unit is the efficient and concerted management of material flows.

Your contact

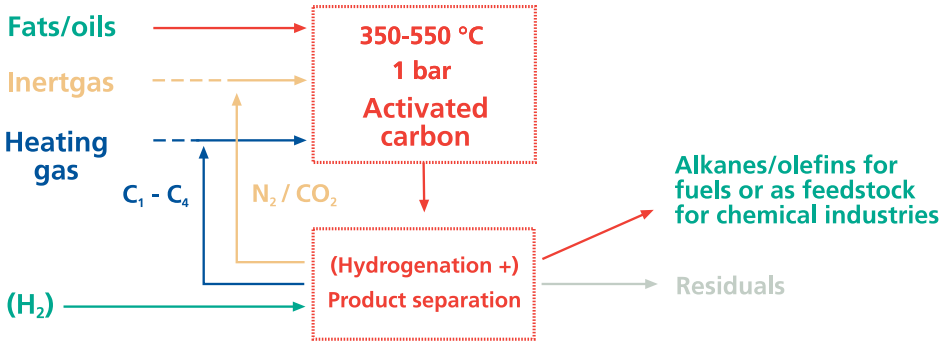
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GREASOLINE® – Deriving Petrol-Quality Fuels from Waste Fats

Several million tons of waste fats (of both vegetable and animal origin) from the food processing industry, fast-food restaurants and other sources accumulate annually in the EU countries. Since 2001, the utilization as animal feed has been prohibited. Energy recovery via incineration is customary, but does not realize the full economic potential of this valuable secondary raw material. Chemically converting highest-quality waste fats (used frying oils) to oil methyl esters to substitute diesel fuel marks the state of the art.

The GREASOLINE® process concept converts waste fats into mixtures of hydrocarbons consisting of the same chemical components as fossil kerosene and diesel fuels. Thus, the resulting fuel is suitable to power vehicles both earth- and airbound. Corrosivity and swelling interactions with gasket material as known from methyl ester fuels do not occur. Since fatty acids can be processed without problems, a wide variety of fats and oils can be processed.

This process concept, under development by Fraunhofer UMSICHT, is pending for international patents. It is based on catalytic conversion reactions at temperatures of more than 350 °C (662 °F) and can be operated in an autothermal mode (i. e. without external energy consumption), using the volatile by-products for reactor heating. Upcoming research will focus on catalytic upgrading within the "hot" part of the process in order to match existing fossil fuel standards. Extracting single components from the product mixture as raw material for the chemical industry is another goal of development. Reusing waste fats and oils the GREASOLINE® way helps reaching the EU commission's aim of replacing 6 % of all fuels in the EU by regenerative resources by 2006 as required by the Kyoto protocol.



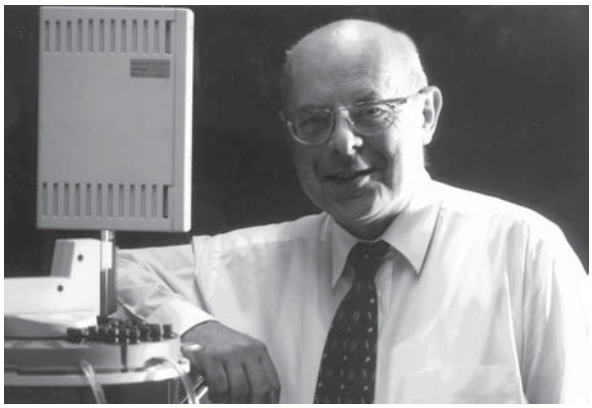
The GREASOLINE® process concept (shown schematically) takes full advantage of the economic potential of waste fats and oils

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"Micro and nano structures open up new product and technology dimensions. Our creativity is demanded to the smallest detail."

[Prof. Dr. rer. nat. Rolf Kümmel, Business Unit Manager Advanced Materials]



We are specialized in the design of high quality materials, which consist of several materials and are suitable for demanding applications. We are especially strong in combining material and process technological know-how.

The Institute

Business Unit Renewable Resources

Business Unit Process Technology

Business Unit Waste Management/-Technology and Adsorption

Business Unit Advanced Materials

Bionic – Innovations from Nature

Microcapsules

Modeling of Dispersed Systems

Expandable Polymers

Business Unit Safety Engineering

Business Unit Energy Technology

Business Unit Energy Systems

Business Unit Know-how and Technology Transfer

Names, Data, Events







Bionic – Innovations from Nature

Knives as Sharp As a Rat's Tooth

The business unit "Advanced Materials" investigates the coarse and fine grinding of visco-elastic and elastic-plastic materials such as thermoplastics and elastomers. Grinding or cutting processes are an important aspect of industrial production. A large portion of today's materials is processed as granules or powder within the process chain. Fine polymer powders are the feedstock for modern sintering and coating processes. Adapted grinding and cutting technologies in terms of mill and tool geometries as well as optimized process parameters are basic requirements for the cost-effective production of products with defined-qualities. Supported by the program "Bionics – Innovations from Nature" of the Federal Ministry of Education and Research, a model for self-sharpening, permanently sharp cutting tools for grinding mills was developed, based on the principle of self-sharpening incisors of rats.

Teeth consist of very hard enamel and softer dentine, a bone-like material. While human teeth are fully coated with a thick layer of enamel, the enamel layer of rodent incisors has evolved into an ultra-thin coating on the front surface. As a result, the soft dentine is exposed to abrasive forces.
Due to the differing hardness of the materials, specific teeth geometries, and permanent growth, rodent incisors wear down through gnawing in such a manner that the enamel protrudes as a knive-sharp edge. Complex enamel structures are integrated into the layer to prevent it from breaking. This principle allows for an enormous cutting efficiency – rats are able to bite through wood, metal and even concrete.

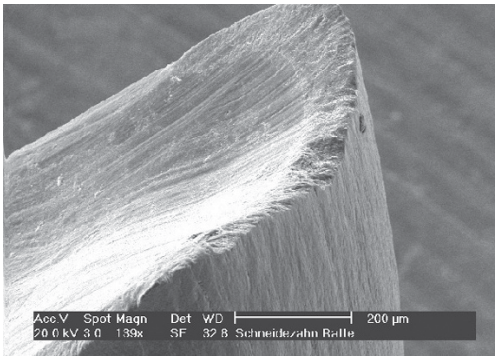


Self-sharpening cutting tools and their biological inspiration (water rat)

A design study was completed to develop a concept for self-sharpening cutting tools for grinding mills, inspired by the self-sharpening incisors of rats. The tools are based on ductile metals in combination with thin ceramic layers. In cooperation with industrial partners, prototypes were manufactured and tested.

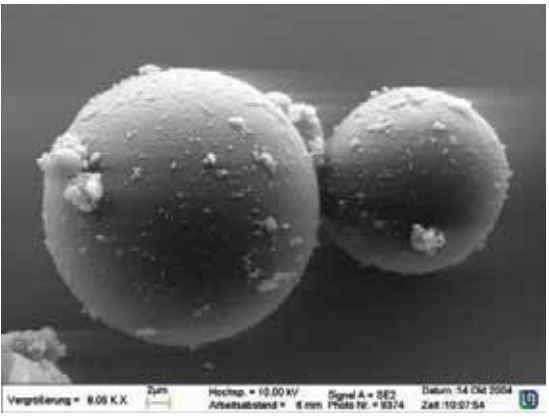
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Evolutionary enamel reduction of rodent incisors allows self-sharpening effects





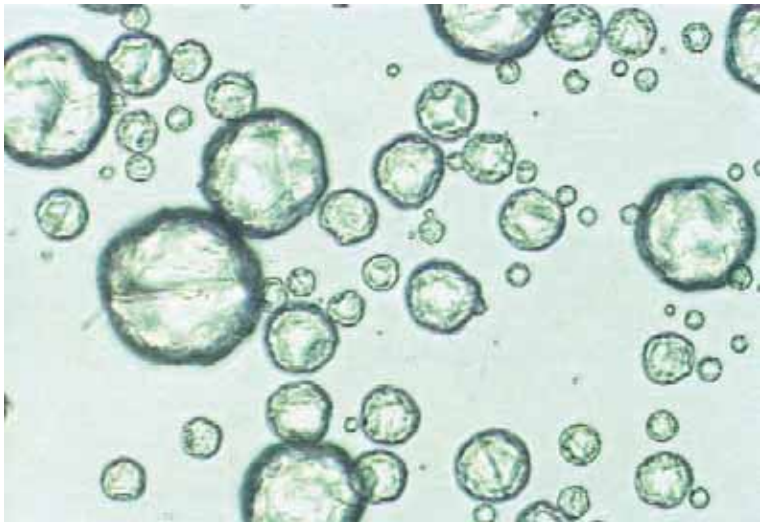
Double encapsulated particle, the primary layer consisting of melamine-formaldehyde resin, the secondary layer of titanium dioxide.

Coated Pigments and Microencapsulated Additives

Tailor-made, individual-particle coatings can offer a profitable solution for applications in which functional pigments need protection, increased compatibility of filler compounds is desired, or in which cross-linking agents, accelerators, lubricants, or flame-retardants are involved. Fraunhofer IAP, ICT, and UMSICHT have cooperated to develop a variety of encapsulation strategies for both liquid and solid materials.
The Fraunhofer Institute UMSICHT specializes in the development of microcapsules as well as coated particles for use in painting systems and plastics. Capsules made out of amino-resins, polyacrylates, polyurethanes, or biopolymers can be produced from monomers, prepolymers and polymers available from any major supplier. The mechanical properties of the wall material, the amount of residual monomers present, and the controlled release behavior of the encapsulated substances determine the wall material best suited for a particular technical application. Encapsulation in the gas phase with transparent and highly temperature-resistant polymers yields especially homogeneous and dense coatings. Under conditions where polymer encapsulation proves challenging, multiple layers of silicon or titanium dioxide can be used to modify the particle exterior. Silicon dioxide is characterized by its transparency and chemically inert behavior. Thin layers of titanium dioxide yield particle surfaces with (photo-)catalytic or optically active, (due to TiO_2's high index of refraction), properties. Typical layers have a final thickness ranging from 20 nanometers to a few micrometers. The capsule wall typically makes up five to fifty percent of the encapsulated particle weight. Fraunhofer UMSICHT has numerous stirred reactors and dispersing machines at its disposal, as well as a synthesis plant, called ParMa that allows parallel synthesis and product development of microparticles and -capsules, suspensions and emulsions. Additionally, vacuum-technology and micro-processing components for mixing and emulsifying allow innovative encapsulation techniques. Fraunhofer UMSICHT offers services concerning everything from microcapsule product development to sample and contract production.

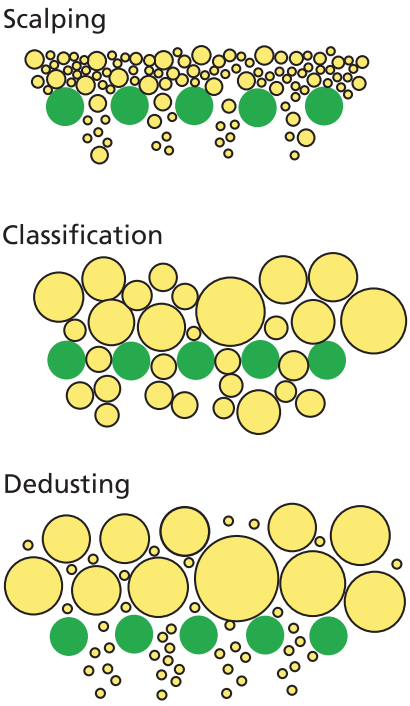
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Process additives encapsulated in polyurethane

Modeling of Dispersed Systems



Different regimes of sieving
(DEM-simulation)

Modeling of Dispersed Systems

Smart materials, which combine high functionality with minimum space requirements, can be developed by combining miniaturization and functionalization. Preferably, the structuring of the material should occur on the level of the single particle, i.e. in the range of micro or nanometer, because boundary-effects at the surface dominate the properties.

As part of an internal research program (WISA*-micro composites), three Fraunhofer institutes (IAP, ICT and UMSICHT) investigated the production, characterization and application of micro structured composite particles.

Dispersed systems such as droplets (aerosols or emulsions) and solid particles are excellent templates for the production of such structured materials. Modelling is often the only possibility to "observe" and investigate the microscopic processes. The necessary multi-dimensional simulations are very complex and require further development.

Fraunhofer UMSICHT is developing and applying different strategies for modelling disperse systems. Gas flows and nano-jets are being investigated via classical molecular dynamics. Crystallization, micro encapsulation and solid formation for spray drying are being described by multi-dimensional population balances. Classification of bulk solids and fracture of single particles are being investigated using the discrete element method (DEM).

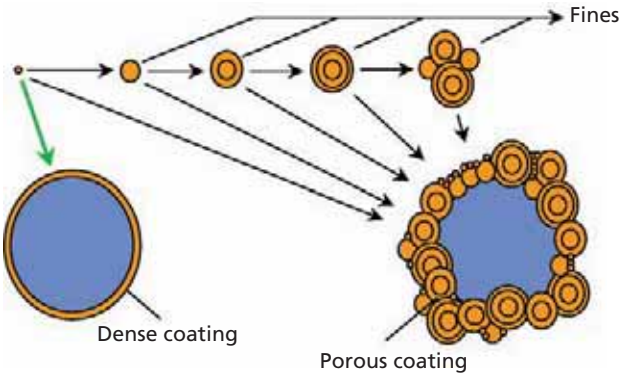
At the present time, the rigorous modelling of mills on a technical scale is not feasible because of the complex interactions within the system. Therefore, the existing experimental data are analyzed with data-based methods such as neuronal networks and fuzzy algorithms.

Volume-of-fluid-methods are used to calculate the development of free surfaces during the formation of droplets and are applied in membrane emulsification.

The transfer of the results based on a microscopic length scale to the technical scale is being investigated in order to enable the modelling of complete apparatuses and processes.

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Micro encapsulation (2-D population balance model)

* WISA = market-oriented strategic alliances of the Fraunhofer-Gesellschaft

Expandable Polymers for Sealing Technology

Highly expandable and gel-forming polymers, also called superabsorbent polymers (SAP), are used in an ever-increasing number of technical applications.

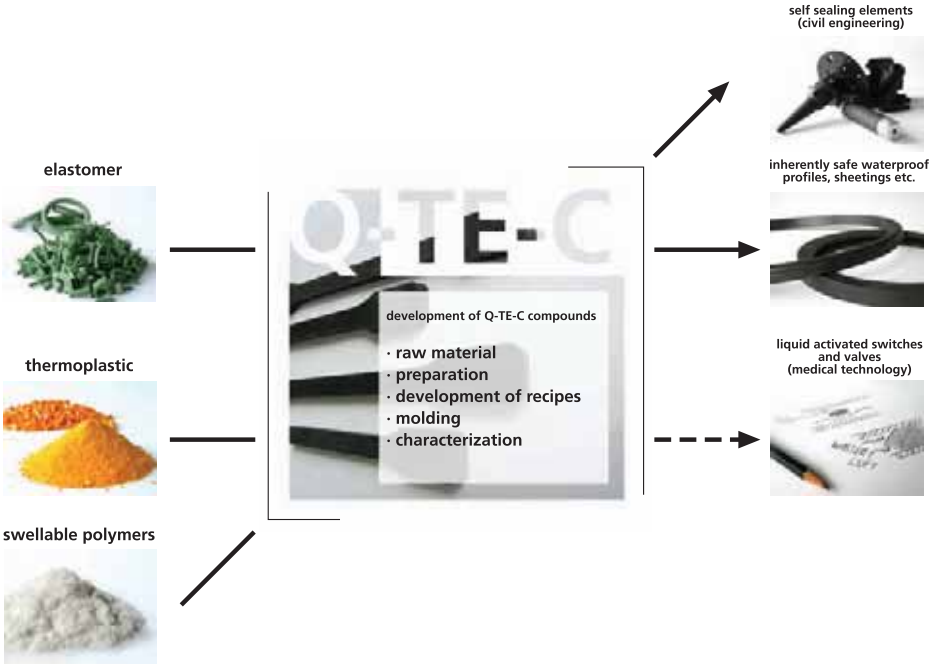
These materials are mainly used for the absorption and storage of liquids in hygiene products, e.g. diapers. Upon contact with aqueous solutions, SAP expand by forming a gel and reach weights of up to 1000 times their dry weight. In this process, the absorbed liquid remains stored even under pressure.

These properties are also ideal for using SAP in the area of sealing technology. Fraunhofer UMSICHT develops concepts and materials for sealing technology on the basis of expandable polymers.

They are applied, for example, in civil engineering (for sealing joints) and sewage technology (for sealing pipe connections).

In the context of a research program* co-financed by Industrial Public Research (Industrielle Gemeinschaftsforschung, IGF) and in cooperation with the research institute for underground and pipe engineering (FITR), UMSICHT is developing a self-repairing pipe seal, which can be monitored.

The latest focus of the business unit is the development of expandable thermoplastic elastomer composites (Q-TE-C®).



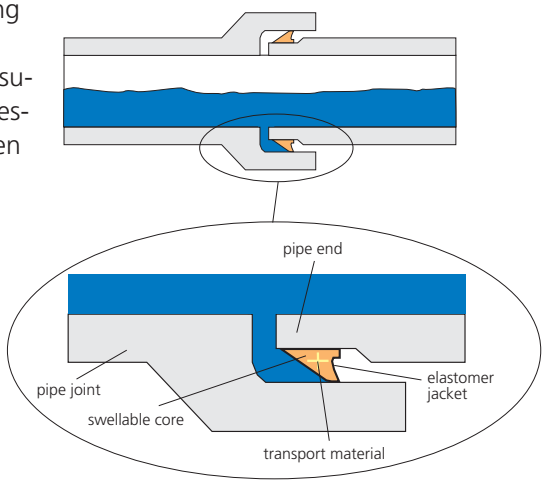
Functional thermoplast-elastomer-composites

This new material has properties similar to those of rubber, while, at the same time, being easy to process (similar to thermoplastic materials), exhibiting excellent recycling characteristics, and having the ability to expand. It provides the basis for a new generation of sealing materials.

Fraunhofer UMSICHT has a variety of measurement and analytical instruments for detailed design and forming of sealing materials at its disposal. In addition to standard analyses, a measurement method for the expansion pressure of gel-forming polymers has been developed.

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Self-repairing sealing for sewage systems

* AiF ZUTECH, Project-No. 98 ZBG

"The connected information technology provides businesses with useful tools to meet document or evidence obligations. With certainty!"

[Dr.-Ing. Stefan Schlüter, Business Unit Manager Safety Engineering]



Our business is the safety-technological assessment and layout of industrial plants and processes, securing of pipeline systems, and the provision and maintenance of safety-relevant information.

The Institute

Business Unit Renewable Resources

Business Unit Process Technology

Business Unit Waste Management/-Technology and Adsorption

Business Unit Advanced Materials

Business Unit Safety Engineering

Exceptional Smoke Management Systems

Focus on Explosion Protection

Pipeline Networks

Solutions for Operational and Plant Safety and Hazardous Materials Transportation

Business Unit Energy Technology

Business Unit Energy Systems

Business Unit Know-how and Technology Transfer

Names, Data, Events







Exceptional Smoke Management Systems

Hot Smoke Tests Prove Effectiveness of Exceptional Smoke Management Systems

Unusual building geometry and escape routes in extraordinary buildings often necessitate a tailor-made smoke management system. As part of the commissioning procedure, hot smoke tests in the building are increasingly employed in order to test the effectiveness of the installed smoke management system. Fraunhofer UMSICHT has developed and patented a hot smoke tests procedure and carries out tests accordingly. Within the building subject to the test, hot smoke is released that behaves like real smoke but without causing any harm to persons or damage to the building and its interior. Smoke flow can be readily observed, and additional recording of the temperature and gas concentration at various points within the building during the smoke test permits a reliable evaluation of the effectiveness of the smoke extraction.

A hot smoke test with a total heat release rate of 0.3 MW was conducted in an expansive multi-purpose area within a newly constructed soccer stadium in Mönchengladbach. Gas-fuelled fan burners and pool fires were used as heat sources. It could be demonstrated that formation of a stable hot smoke layer underneath the ceiling with a remaining fresh-air layer at the floor would provide for the usability of the rescue paths and for safe evacuation in case of a fire.

In an open multi-story car park, the impact of a noise-protection facade on smoke extraction had to be evaluated. The hot smoke test revealed that smoke management of the construction under test was equivalent to the generally accepted open standard construction. Smoke removal was even enhanced by the facade making the facility less vulnerable to adverse wind effects.

These and other tests have shown that effective smoke management requires a balanced concept of smoke extraction and make-up air supply in combination with reliable detection and control devices.



Ceiling smoke layer in a multi-purpose area



Hot smoke test in a multi-storey car park

Your contact

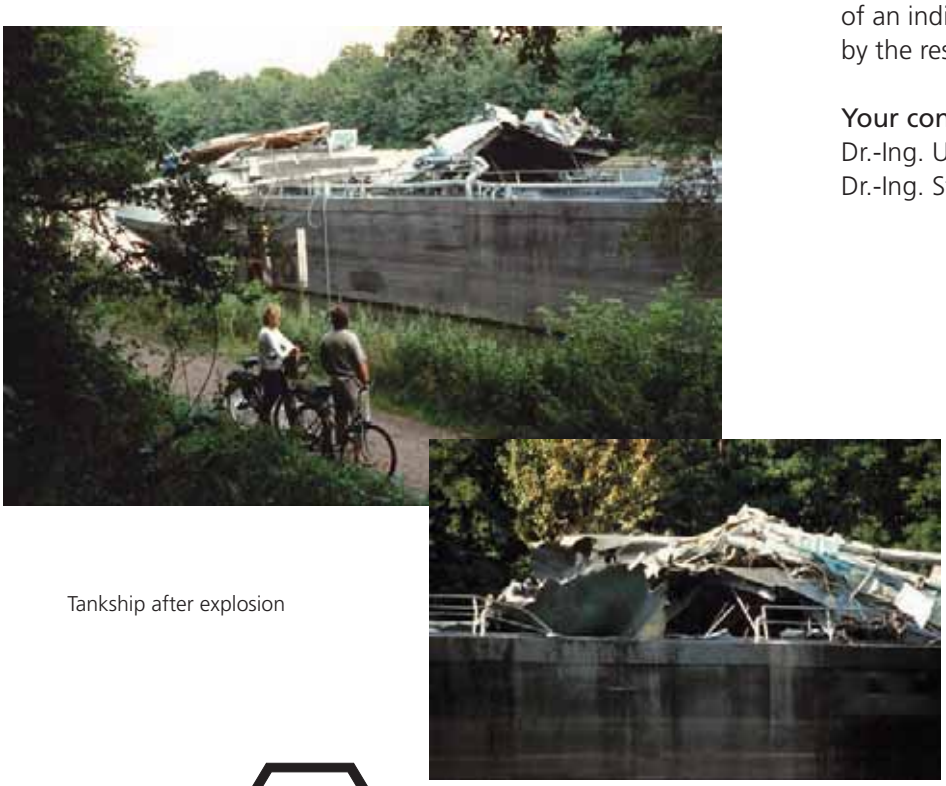
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Focus on Explosion Protection

With the commencement of the Betriebssicherheitsverordnung (Ordinance on Industrial Safety and Health) in 2002, a clock has begun to tick for many companies in Germany: By the end of December 2005, all areas potentially at risk from explosive atmospheres formed by gases, vapors, mists or dusts have to be evaluated and the results of this evaluation and the measures for protection have to be documented.
Aside from large industrial enterprises that handle vast amounts of flammable substances, a great number of small and medium production companies will also be affected by the new legal requirements.
The abolishment of old ordinances, combined with the loss of well-established classifications such as those for flammable liquids (AI, AII, AIII, and B), complicates the picture further. The manufacturers or operators who are used to associate explosion protection mainly with electrical devices are now required to take other sources of ignition such as mechanical devices or static electricity into consideration.
Having contributed to the drafting of a non-binding guideline on explosion protection for the European Commission in 2002, Fraunhofer UMSICHT worked on the development of practical guidelines and tools for explosion protection at the workplace. In collaboration with partners from industry and with Weka Media GmbH, a software tool has been developed which is particularly suited for small and medium-sized enterprises by supporting them in completing explosion protection documentation in due time.
A completely different challenge resulted from the evaluation of an industrial process for the production of mass chemicals in terms of explosion protection. A German engineering company designs such production facilities in various parts of the world and is, therefore, subject to different explosion protection requirements for basically the same technology.
Based on internationally accepted explosion protection regulations and standards, Fraunhofer UMSICHT has performed an assessment of explosion hazards and has derived area classifications for these production plants which can form the basis of an individual plant assessment to be conducted by the respective plant operator.

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Tankship after explosion



The yellow-black triangle warns of a hazardous area ("do not enter with ignition sources"), the hexagon symbolizes that a device marked in such a way is suitable for use in hazardous areas.

Pipeline Networks



Pipeline pilot plant at
Fraunhofer UMSICHT



ABS-Armatur®

Analysis and Optimization of Pipeline Networks

Dynamic processes in pipeline networks – such as sudden changes of the flow velocity, plug flow, or contact condensation of steam and water – often cause pressure surges, and cavitation or condensation hammer. As the length of the pipeline net increases and valve closure times decrease, the risk of exceeding force and pressure limits of the system grows rapidly.

Based on that background, Fraunhofer UMSICHT works on the planning of pipeline systems including component parts, on the calculation and optimization of pipe flows (static, dynamical), and the identification of individually optimized operating guidelines for the prevention of pressure surges and cavitation hammer. Expert studies on safety aspects and the availability of pipelines and components, valve testing, and on the analysis of pipeline systems (on-site measuring of pressure and force peaks) complement our range of services.

Frequent leakage in lubricant supply systems of an automotive manufacturer led to longer operational interruptions. As a result of the on-site examination of the pipeline system, fast dynamic flow processes were detected as the leakage cause using a high frequency pressure measuring technique. To ensure the highest possible availability, investigations were complemented by analyses, evaluations and operational optimization. The pipeline system has operated failure-free since.

A newly developed valve type was introduced in the market in co-operation with a butterfly valve manufacturer. Analyses at the company's own plant yielded new insights into flow behavior which will enable the manufacturer to offer a more efficient customer service to the company's clients, resulting in an optimum placement of the novel product on the market.

Several tests on conventional methods to control non-optimum operating conditions were conducted under practical conditions on the company's own pipeline test plant. As a result of the close, interdisciplinary collaboration with international research institutes, two cost-efficient methods for the prevention of pressure surges and cavitation hammer were developed (ABS-Armatur® und KAVITAS®).

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Solutions for Operational and Plant Safety and Hazardous Materials Transportation

Information Systems for Operational Safety and Organization

"The Ten Commandments contain 279 words , the American Declaration of Independence 300, but the decree of the European Community regarding the import of caramel drops exactly 25 911", Franz Josef Strauß once complained. Entrepreneurs are faced with a similar corpus of legislation concerning the Health and Safety at Work Act or environmental protection. In addition to the task to be permanently up to date regarding the changes in laws, employers are obliged to interpret the regulations for operational practice.

Modern IT concepts and systems for the automatic generation of high-level knowledge support the management of operative tasks relating to the protection of humans and the environment – in a safe and efficient manner. Intuitive access mechanisms and interactive compendiums support the transfer of knowledge to the whole value-added-chain and guarantee reliable results.

Based on operative data from estimations of danger, plant documentations, operating instructions and existing management-systems, in addition to external sources of information and operational competence, the operative liabilities are easily verifiable.

Additional systems supporting knowledge-management in the field of hazardous materials transportation expand the portfolio of the department "Technical Information Management" at Fraunhofer UMSICHT.

Examples of recent developments include the software solution LAGERguide, an interactive compendium for storage of hazardous materials and waste, the information network solution DUBAnet® for the management of integrated occupational safety and environmental protection, and the GGAVguide for the identification of legal conditions regarding the transport of low quantity hazardous materials.

Companies which apply these individually adapted software solutions reduce time and work spent on inquiries as well as the chance for errors associated with more convoluted methods of gathering information. Uncertainties regarding current laws are erased and liability claims can be prevented.

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www.DUBAnet®.de



"Technological progress is only possible with efficient, sustainable, and competitive energy technology. To accomplish that, we have to follow the trail of efficiency."

[Dr.-Ing. Wilhelm Althaus, Business Unit Manager Energy Technology]

We develop energy conversion plants for highly efficient and economic electricity, heat and cold supply. Our strengths lie in the energetic utilization of biomass (wood and sewage sludge) and everything relating to the extraction, cleaning, and application of biogenic gases and low BTU gases.

The Institute

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Business Unit Process Technology

Business Unit Waste Management/-Technology and Adsorption

Business Unit Advanced Materials

Business Unit Safety Engineering

Business Unit Energy Technology

Use of Sewage Gas in a Molten Carbonate Fuel Cell

Oxygen Enrichment

Coal Mine Methane (CMM) Project Teutoburgia

European investigation on tar formation and tar measurement in gasification processes

Business Unit Energy Systems

Business Unit Know-how and Technology Transfer

Names, Data, Events







Use of Sewage Gas in a Molten Carbonate Fuel Cell

Use of Sewage Gas in a Molten Carbonate Fuel Cell

MCFC* fuel cell technology can convert sewage gas into electric power with a high efficiency of about 50%. In small and middle capacity ranges typical for sewage treatment plants, gas engines are limited to an electrical efficiency of about 30%. The formidable efficiency of fuel cell technology leads to an additional reduction in greenhouse gas emissions.

Currently fuel cells are primarily designed for and operated with natural gas, neverthless, the application of sewage gas represents a tremendous opportunity in the future. Fraunhofer UMSICHT and the Wupperverband tested if operation of a molten carbonate fuel cell with sewage gas is possible under real operating conditions of a sewage treatment plant. The project was funded by the North Rhine-Westfalia Ministry for Environment and Nature Protection, Agriculture, and Consumer Protection. The main focus was on the development of an adapted upstream gas cleaning system, on the determination of minor component threshold values of the MCFC, and on the analysis of the influence of fluctuating sewage gas quality on fuel cell operation.

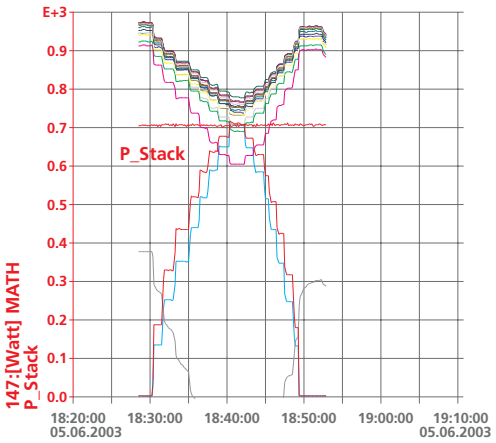
The developed adsorptive sewage gas cleaning system exhibited a robust and reliable operation. Concentration peaks of the contaminants were removed employing two stages of activated carbon adsorption. The operating costs of a commercial gas cleaning system are about 0,014 Euro/Nm^3. Cost reduction potential exists regarding to the choice of adsorbents and heat integration.

The test duration of the molten carbonate fuel cell connected to a sewage system shows that input of sewage gas is possible without any problem after the separation of the catalyst poisons (sulfur, siloxanes, chlorinated hydrocarbons). These components are removed to final concentrations of less than 0,1 ppm. The external reforming concept realized in the MCFC test facility has proven to be of advantage with respect to the use of renewable gases due to higher flexibility concerning operational parameters of the plant (temperature and gas composition). Additionally, the reformer can take on the function of a police filter for the stack adding overall system redundancy. This reduces possible damage costs in case of failure of the gas cleaning system.

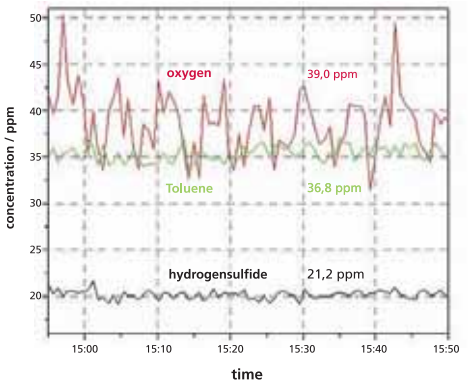
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* MCFC = molten carbonate fuel cell



Load and voltage profile of the MCFC-Stacks



Concentration profile of some minor components in the sewage gas



MCFC test facility at the sewage plant Wuppertal-Kohlfurth

Innovative Technology for Industrial Heat Applications

Oxygen enriched air for combustion can be used in various industrial applications due to the resulting reduction of inert gas content, specifically nitrogen. This is particularly benefitial for thermal processes, heating applications for metal smelting, semi-finished products and workpieces, thermal use of lean gas or aerobic wastewater treatment plants.

A new gas separation method for oxygen enrichment of air based on innovative modular membrane technology has been developed by Fraunhofer UMSICHT. A mobile oxygen enrichment plant for airflow up to 550 Nm^3/h achieving an oxygen content of 28 % was constructed for application tests.

Effective oxygen enrichment of combustion air was successfully realized in a heating system for foundry ladles (capacity of 80 t) in a steal mill which was subsidized through one of the main German R&D sponsors Deutsche Bundesstiftung Umwelt (DBU).

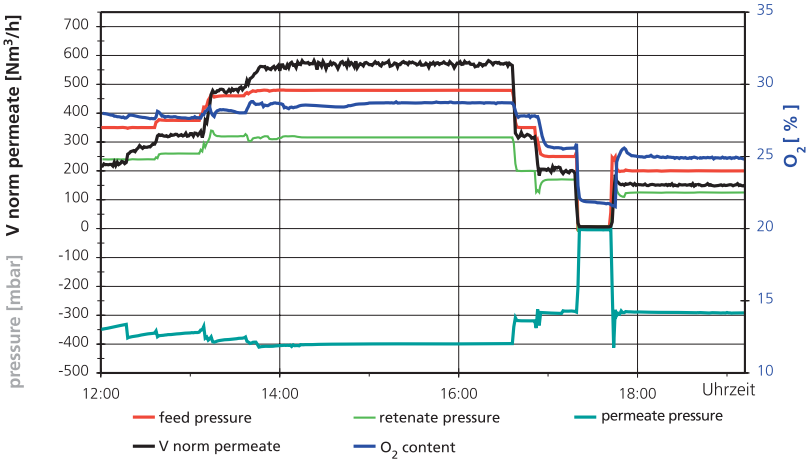
A natural gas burner with a performance range of up to 2 MW – equivalent to a gas consumption of 200 Nm^3/h – in an existing heating system was operated using our new process solution. As a result, improvements were achieved with regard to combustion characteristics, stabilization of the flame cone, recirculation of the waste gas and increase of the flame temperature.
The heat radiation also increased based on the higher flame temperature. This effect benefits heating of the foundry ladle by reaching the necessary temperature level with an optimized flame geometry.

The modified combustion process was optimized with regard to fuel efficiency and heat transport mechanism. The required natural gas could be reduced by up to 80 Nm^3/h, so that our process solution led to a primary energy reduction by 40 %.

Cost-benefit analyses show that innovative membrane separation processes for enrichment of oxygen can be used for cost reduction in several technical processes, particularly in elevated temperatures regimes.
Optimal use of resources, high energy efficiency and reduction of emissions make an important contribution to environmental protection.

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The diagram shows different operating states of the oxygen enrichment plant

Coal Mine Methane (CMM) Project Teutoburgia

First German Joint Implementation Project in the International Emissions Trading System

According to the Kyoto-Protocol Annex 1, countries are obligated to reduce their greenhouse gas (GHG) emissions. This can be accomplished by trading of emission credits between the countries but also by using project based mechanism to reduce GHGs. Joint Implementation (JI) is a project based approach between two Annex 1 countries. Clean Development Mechanism (CDM) is also project based, but involves the collaboration between an Annex 1 country and a developing country, which has no obligation to reduce GHGs.

Fraunhofer UMSICHT accompanied the CMM project "HER-TEUTO" of Stadtwerke Herne AG from its early stages until it started production. In collaboration with its spin-off Emissions-Trader ET GmbH, Fraunhofer UMSICHT achieved the first approval by the German government as a JI-project with Germany as the host country. It was also the first approved JI-project worldwide on the basis of CMM.

Within the project "HER-TEUTO", a directionally drilled well to a mining gallery of the abandoned coal mine Teutoburgia (in Herne) delivers about 1 million Nm^3 of CMM per year, which is used for power and heat generation. In the future, the annual output will be around 16 million kWh of power. Additionally, 510 houses of renovated former miner homes will be supplied by environmentally friendly produced heat.

After preparing a baseline study, a Project Design Document and other relevant documents in March 2004 Stadtwerke Herne AG got the first "Letter of Endorsement" by the German Federal Ministry of Environment, Nature Conservation and Nuclear Safety, the first step to participate in the international emissions trading scheme.



510 renovated former miner houses of the housing estate Teutoburgia will be supplied with environmentally friendly produced heat.



Former pit head frame of the abandoned coal mine Teutoburgia Herne

The emission reductions of this project were offered to the international Dutch Tender ERUPT-4, which purchased carbon credits from international JI-projects to fulfil the Kyoto obligations of the Netherlands. After the project was validated by an independent Validator (DOE) the Ministry of Environment issued a "letter of approval" for the project. After the offer had passed stringent selection criteria by the ERUPT assessment team, the Dutch government finally decided to purchase the carbon credits (ERUs) from the project "HER-TEUTO". Now all requirements are fulfilled so that a minimum of 50,000 tons of CO_2 equivalent (ERUs) per year will be sold to the Netherlands from this project starting in 2008.

On the basis of this success story a number of follow-up projects in Germany and internationally were initiated.

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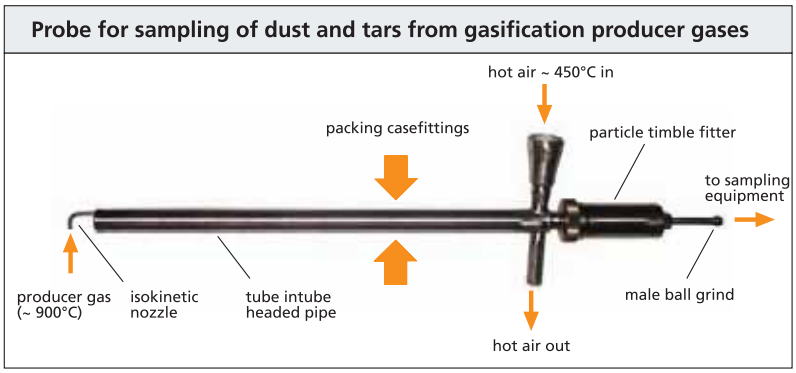
European Investigation on Tar Formation and Tar Measurement in Gasification Processes

Effective detection and measurement of impurities is essential for the technological improvement of gasification processes utilizing solid (bio-)fuels. A European joint project has, therefore, been started in order to develop and test a standardized method for both, tar and particulate determination.

Within the project "Tar Measurement Standard – Sampling and Analysis of Tar and Particles in Biomass Producer Gases", Fraunhofer UMSICHT cooperates with other European institutes.

Practical tests of the developed method were simultaneously carried out by the project partners* under identical conditions using authentic gas and cleaned biogas at UMSICHT's CFB-gasification plant. The facility had been equipped with 6 hot valves on the gas pipe for the practical test through which the single sampling probes could be inserted.

The first day was spent on assembling the technical equipment of the institutes and on starting up the wood gasification plant. On the second day, each partner probed 6 samples of producer gas downstream of a catalytic tar reformer and, therefore, at a low tar level. The third day was used for sampling the raw gas downstream of the gasifier 4 times. Initial preparation of the samples was directly carried out at UMSICHT's lab facilities; subsequent analysis and evaluation of the results was done by the partners according to agreed upon rules and standards.



Set-up of a heated probe for sampling of tar and particulates

Sampling at the gas pipe while the gasifier was operating worked without major problems. The difficult sampling conditions with authentic gasification gas are useful to prove the method and to identify areas for further optimization. Results from the analysis and evaluation will provide a range of variance and deviations to be considered in standardization of the method.



Fluidized bed gasification plant at Fraunhofer UMSICHT, Oberhausen

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* = Technical Research Centre of Finland (FIN), DTI Danish Technological Institute, (DK), BTG Biomass Technology Group BVC (NL), ECN Energieonderzoek Centrum Nederland (NL), TU Technische Universität Graz (A) and Fraunhofer-Institut UMSICHT (D)



"The boundary conditions change, the demand for inexpensive energy remains. Modern energy systems have to fit into this conflicting system."

[Dr.-Ing. Christian Dötsch, Business Unit Manager Energy Systems]

We combine fossil and regenerative energy carriers with centralized and decentralized conversion processes into custom-fit, economically, and ecologically balanced systems, which make best use of local synergies. Our strength lies in the integration of energy systems into existing and new supply systems and in their efficient utilization.

The Institute

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Business Unit Process Technology

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Business Unit Advanced Materials

Business Unit Safety Engineering

Business Unit Energy Technology

Business Unit Energy Systems

Energy Economy

Gas Cleaning

CryoSol® – a High Performance Coolant

Steam Jet Ejector Chiller Technology

Business Unit Know-how and Technology Transfer

Names, Data, Events







Decision Support for the Energy Industry

Increasing competitive pressure and complexity of the economic, political and technical environment require more efficient strategies for planning and managing power supply systems in the future. System models, scenarios and simulations contribute to a forward-looking and transparent optimization of the operational and planning tasks.

As part of the training program "jupiter", 15 emission-intensive enterprises prepared for the European Union Emission Trading System, which started in 2005. They were able to test the most important strategic options for emission trading and develop suitable strategies such as purchasing and selling emission allowances, carrying out CO_2-abatement projects and utilizing flexible Kioto machanisms (JI/CDM*) via internet simulations. Furthermore, numerous companies were consulted on the fundamental rules, opportunities and risks of emission trading, allocation of emission allowances, CO_2-monitoring and trading strategies. The most important aspects of these activities were published in the book "Emissionshandel**".

In order to remain competitive in the long-term, industrial companies and public utilities have to take advantage of energy trading and purchase power at the market price. However, dealing with the price risks associated with the market requires a hedging portfolio management. Since this would lead to unproportional expenditures particularly for smaller market participants, the IT tool "SpOt" was developed. It automates the management of power purchasing portfolios. Based on the characteristic risk aversion of the enterprise, the optimum hedge using derivatives is calculated via scenario-based, stochastic optimization. After the completion of the scientific research in this field, "SpOt" is currently being implemented together with the partners "sas Institute" and "Cap Gemini".



Applying methods from system analysis with respect to uncertainties is gaining more and more significance in a changing energy market and, therefore, represents a focal point of the new Fraunhofer Alliance "Energy", which aims at optimizing complex energy systems such as the control of distributed power systems or the optimal integration of fluctuating renewable energy.

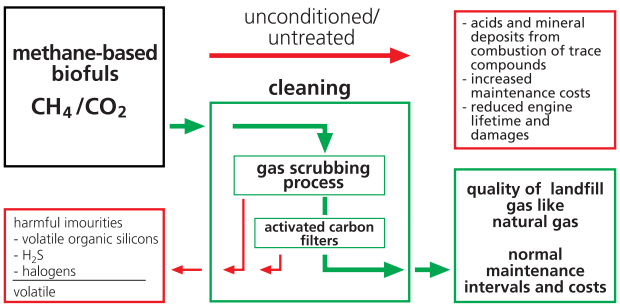
* Joint Implementation: Cooperative projects of two industrial nations for emission reduction (see also p. 62).

CDM = Clean Development Mechanism: An industrialized country carries out projects for emission reduction in a developing country and profits from emission credits.

** Emissionshandel - economic principles, legal regulations and technical solutions for climate protection; Michael Lucht/ Gorden Spangardt; Springer



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Multistage process for landfill gas cleaning

Gas Cleaning -Purification of Landfill and Biogas

In landfills, sewage-treatment and agricultural biogas plants large amounts of polluting and hazardous gases are generated, which have to be sampled and treated. The large greenhouse potential of methane could be reduced to about 5 % by incineration. Due to the high energetic value of these gases, utilization in gas engines for electricity generation is well established. Power generation, thus, has become an important economic factor in waste treatment.

Unfortunately, biogenous gases contain hundreds of other components some of which result in severe damages, corrosion and expensive maintenance costs to the gas engine. Especially in landfill gas, several volatile organic silicon compounds (VOS), halogenated carbons and sulfur increasingly cause problems for the power plants and could ultimately make operation uneconomical.

In cooperation with an industrial partner, R&D-work was carried out by Fraunhofer UMSICHT to develop a new gas cleaning process especially suited for landfill gas. The project was supported by the Deutsche Bundesstiftung Umwelt. Based on previously developed processes for bio and digester gas cleaning using activated carbon, a multistage process was developed, combining an absorption, a catalytic and an adsorption unit. An extensive investigation program performed on several landfill sites showed a significant reduction of both VOS and various other trace compounds. Cleaning of polluted biogases nearly to natural gas quality is economically feasible with this method. Even conventional catalytic flue gas cleaning technologies could be added.

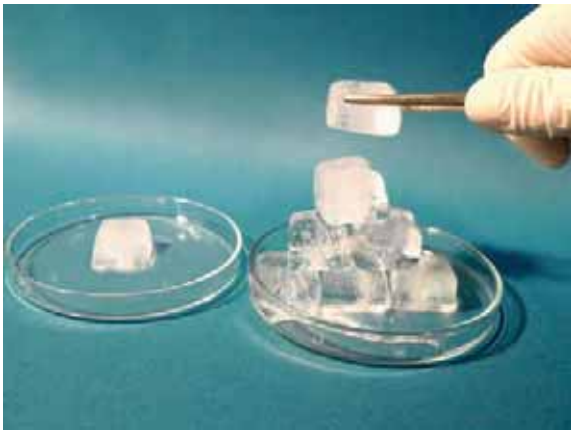
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High temperature incineration flare for landfill gas

CryoSol® – a High Performance Coolant



CryoSol® has a seven times higher cooling capacity in comparison to water

CryoSol® is a Suspension of Very Fine Ice Crystals with Excellent Cooling Capacity

CryoSol® is an ideal solution for short-term cooling load peaks as needed in air conditioning systems, the chemical industry, dairies and breweries. CryoSol® is a pumpable, completely nontoxic and liquid refrigerant medium which is most suitable for low-temperature processes close to the freezing point of water.

Within the scope of a research project – promoted by AiF* –, Fraunhofer UMSICHT has developed and erected an automatically controlled pilot plant for laboratory air conditioning. Important parameters for planning and construction have been identified. At present, Fraunhofer UMSICHT is realizing a first demonstration plant for peak load cooling supply in an office building with an estimated start-up in October 2005.

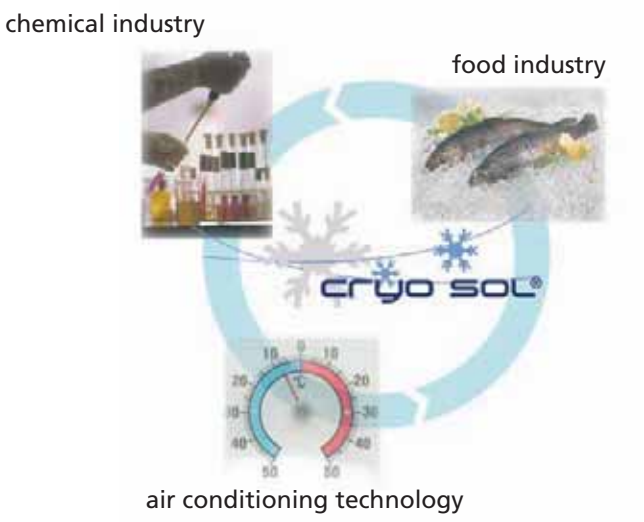
Another important R&D area is direct food cooling, which can be realized with CryoSol® (for food), e.g. for pasta, meat, fish and cheese (mozzarella). In contrast to conventional systems using crushed ice and batch-operation, a continuous operation should be realized. The improved efficiency leads to significant savings in energy costs.

Another application for CryoSol® is the growing field of mobile cooling. Waste heat used in thermally driven chillers is an excellent way to generate CryoSol®, which can then be containerized and transported to the customer. The container system replaces the electrically driven refrigerating machine on site. A report shows that a cost-effective operation is possible for applications such as air conditioning systems (hotels, office buildings) and food cooling (supermarkets).

Replacing electrically driven chillers by mobile cooling results in significantly reduced emissions and leads to a considerable saving of primary energy.

The enormous waste heat potential of the combined heat and power generation and processing industry can be harvested for cooling applications using CryoSol®.

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* AiF = German Federation of Industrial Cooperative Research Associations

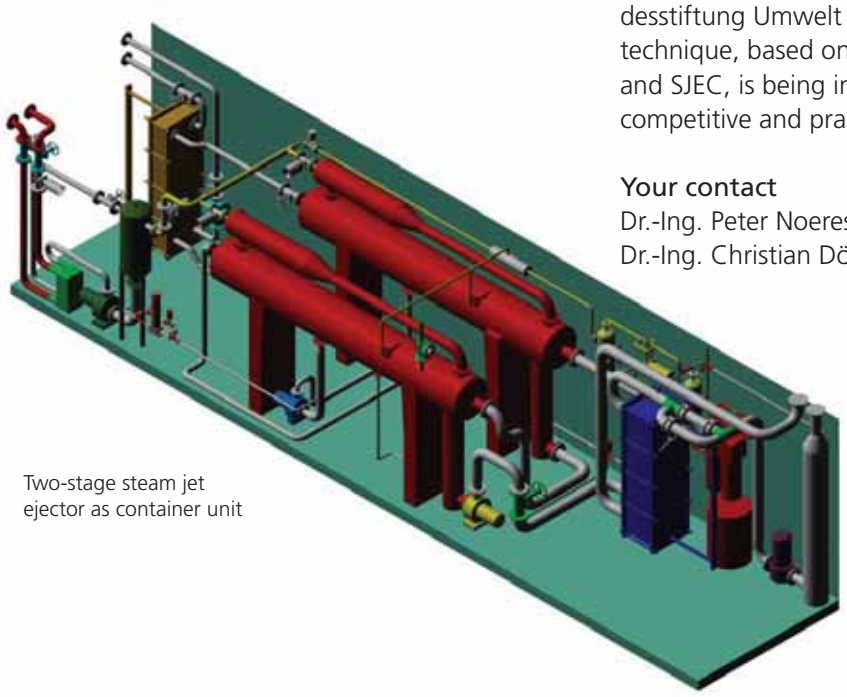
Solar Cooling and Combined Heat, Cold, and Power Generation (CHCP)

In the summer time, chilled water demand and the availability of solar energy appear simultaneously. Solar cooling and concepts of combined heat, cold, and power supply (CHCP) are an ideal field of application for thermally driven chillers. These techniques can achieve economic viability in countries with a large supply of solar energy, e. g. in Mediterranean countries. For countries with only a limited availability of solar energy such as Germany, thermally driven chiller systems are promising in combination with CHP-plants or to use waste heat, e. g. from industrial processes.

Fraunhofer UMSICHT has many years of experience in the field of thermally driven chiller systems. Apart from the integration and the automation of thermally driven chiller systems, the development of new chiller cycles is the main focus of our activities. Particularly promising are steam jet ejector chiller cycles (SJEC), which reach higher year-average coefficient of performance (COP) values compared to standard chiller systems due to their advantageous operational characteristics with short response times and very good part load behavior. SJEC-technology is very simple, robust, low-maintenance and uses water as refrigerant. This technique offers a high cost reduction potential.

Fraunhofer UMSICHT has erected two demonstration plants (1.: paper mill August Köhler AG: 1 MW chiller capacity, 2.: Energieversorgung Gera GmbH: 1.2 MW chiller capacity). At the moment, a compact-SJEC system as a container-module with a chiller capacity of 100 kW is being developed at Fraunhofer UMSICHT in order to achieve further cost savings through process standardization and optimization. A solar cooling plant with a chiller capacity of 58 kW (vacuum tube collector system combined with an absorption chiller) has been built as a demonstration plant for air-conditioning at Fraunhofer UMSICHT. This system will be studied continually with the goal of operation optimization.

In an additional project, funded by the "Deutsche Bundesstiftung Umwelt DBU", a new kind of solar cooling technique, based on parabolic trough collector systems and SJEC, is being investigated in order to achieve competitive and practical technical solutions.



Two-stage steam jet ejector as container unit

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"Economic growth arises from creative ideas. We support the world-wide implementation and marketing of these ideas through networking and international project development."

[Dr.-Ing. Achim Loewen, Business Unit Manager Know-how and Technology Transfer]



We combine modern management techniques with technology know-how, transfer know-how of the institute into national and international research and development projects, and drive the development and dissemination of technologies, which are adapted to the special needs of the particular countries.

The Institute

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Business Unit Advanced Materials

Business Unit Safety Engineering

Business Unit Energy Technology

Business Unit Energy Systems

Business Unit Know-how and Technology Transfer

Power and Heat Supply in Kostrzyn

Network High Performance Adsorbents

Treatment of Acid Mine Drainages in Pennsylvania

Optimization of Temperature Differences in District Heating Networks

Names, Data, Events







Power and Heat Supply in Kostrzyn

Restructuring of Agricultural Regions in Europe

The Polish town of Kostrzyn exhibits attractive characteristics for intensive co-operation with Germany: Its geographical location right at the German-Polish border (about 1.5 hours drive from Berlin) makes it strategically significant for any kind of traffic and exchange between Western and Eastern Europe. Although several industrial enterprises of other European countries have already set up branch offices in Kostrzyn, the region is characterized by an unemployment rate reaching over 20 percent with an economy still mainly based on agriculture. Therefore, the region is in dire need of new concepts for strengthening its economic power.



Kostrzyn is situated at the Warthe mouth into the Odra river, about 108 km east of Berlin and 150 km west of the Polish town Poznan

On behalf of a Polish foundation for the promotion of renewable energies, Fraunhofer UMSICHT has developed a model project for the generation of power and heat from biomass and has assisted the client in identifying suitable funding instruments.

A biomass-fired combined heat and power generation plant (CHP) with a capacity of 20 MW_{el} and 80 MW_{therm} was designed for the integrated utilization of wood, sewage sludge and other organic sludges.

The sewage sludge could be supplied from municipal wastewater treatment plants around the region to be combusted together with wood or transformed to synthesis gas in a separate gasification unit. Subsequently, the gas could also be burnt in the combustion plant. The drying of the different fuels, required to reach the desired water content, may be performed using waste heat emitted from the power plant.

Based on economic and liquidity forecasts over a period of 20 years, the planned biomass-fired combined heat and power plant will be economically feasible even under conservative assumptions.

Besides the CHP plant, a regional training center is also planned. First proposals for a modularly structured professional qualification program have already been completed. Using the flexibility of a modular system, which allows for a wide selection of courses and combination of qualification/instruction modules, this center will offer advanced training programs tailored to the specific needs in the renewable energies sector of both enterprises and individuals.

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The small town of Kostrzyn with roughly 17 000 inhabitants is dominated by agriculture

Network High Performance Adsorbents

Numerous innovative enterprises which develop, produce, and market plants, products and services in the field of emission reduction, are located in Teterow in the German state of Mecklenburg-Western Pomerania. Likewise, Fraunhofer UMSICHT has established a branch, which operates a laboratory for the development and optimization of activated carbon. To ensure and expand the innovative capacity of the region, the exchange of know-how and experience among the enterprises has to be promoted. Therefore, six enterprises have joined forces with the research group Teterow of Fraunhofer UMSICHT in order to establish a network.

Along the value-added chain "generation of basic materials – processing of semi-finished products – energy supply – special construction and assembly – sales and distribution", the network partners jointly develop novel products from high performance activated carbons, which may be placed particularly in niche markets. This establishes the Teterow region as a nucleus for the development of innovative and sustainable technologies. Additionally, the network helps gaining access to markets that would be out of reach for the enterprises as individual players.



AiF Day of Innovation, August 31, 2004
Dr Alfred Tacke, State Secretary of the Federal Ministry for Economics and Labor (BMWA), hands over the winners' certificate for the Fourth Tender of the "Netzwerk Management Ost Programm (NEMO)" to Dr. Sylke Palitzsch



Biomedical laboratory Teterow (BMTT), domicile of the Fraunhofer UMSICHT branch, specialized in the development and optimization of activated carbons

Development work focuses on the many everyday „small emissions" and the resulting detrimental impacts on consumers, as this offers potential to open numerous market niches for new, specialized products. Furthermore, the network performs projects for the industrial sector, including e. g. the development of innovative filter-exchange systems for waste incineration plants and landfills, or for gas separation systems using novel activated carbon monoliths (cf. page 43).

Fraunhofer UMSICHT coordinates the network activities supporting the partners in the development and realization of their project ideas. The offered services range from the completion of market studies over marketing concepts to the identification of and application for funding.

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Treatment of Acid Mine Drainages in Pennsylvania

Treatment of Acid Mine Drainages in Pennsylvania

In cooperation with the U.S. Department of Agriculture and the University of Pittsburgh, the Fraunhofer Office in Pittsburgh examined methods for the treatment of water bodies that have been polluted by mining activities. Pennsylvania has more than 4 000 kilometers of rivers which have been heavily affected by discharges from (abandoned) mines, so-called "Acid Mine Drainages" (AMD).
Conventional treatment techniques are based on the addition of lime and surface aeration. The pH value of the water is increased and oxygen is added resulting in the precipitation of metals, in particular iron. However, this creates large quantities of calcium sulfate-rich sludges, which have to be disposed of at very high costs.
Alternative agents for increasing the pH value and the use of a specific apparatus ("turbojett") for an optimized insertion of atmospheric oxygen into the water to be treated were examined. Sludges with high contents of iron hydroxides could be generated, and various fields of their possible utilization were identified. Among other applications, they may be used as pigments for the production of paints and construction materials, or as adsorbents for the purification of other wastewaters. Furthermore, their use as soil amendment and, after mixing with manure, as fertilizer was explored in detail. Sales revenues from these products might cover part of the treatment costs of the discharges in the future.

All acid mine drainages are unique in their composition and, thus, generate different treatment products. The utilization of iron oxide seems reasonable if agents based on sodium hydroxide solution are used for precipitation. Tests also showed that when using the turbojett, the oxidation and precipitation velocity turned out to be significantly higher than predicted by reaction kinetic models. As a result, this technique has proven to be well suitable for the treatment of acid mine drainages.

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Iron hydroxide is one of the natural iron oxide pigments and was very popular among fine artists as "Ocher" or "Persian Red" for its intensity

Optimization of Temperature Differences in District Heating Networks

District heating networks deliver heat in the form of hot water to the customers through a pipeline system. After being used for space heating and domestic hot water supply, the cooled water is pumped back to the generation plant in a second, parallel pipeline system to be heated up before reentering the cycle. The higher the temperature difference between the supply and the return pipes, the more energy can be transferred. Insufficient cooling of the water at the consumers causes increased return temperatures and volume flows. This again leads to increased pumping costs and heat losses and, in the worst case, to insufficient transport capacities of the net.

The International Energy Agency (IEA) funded a project conducted jointly by ZW Energiteknik, Sweden, the Fraunhofer Office in Pittsburgh, and the Korean District Heating Corporation, aiming at the identification of consumers who considerably contribute to increased return temperatures due to the malfunctioning of their installations. Fraunhofer's work was to develop a method that can be used to calculate a target return temperature for each consumer.

Therefore, mathematical models were developed based on the technical design of various types of consumer substations. With these models and input data such as ambient temperature, total heat demand, supply temperature and time, the respective target temperature for each time step can be calculated and compared to the actually measured temperature. Depending on the operational status, the daytime and the season at which the highest deviations are found, the impact on the total return temperature of the network can be determined and the general type of malfunction can be assessed.





District heating experts visit a palace site in Seoul, South Korea

The project results were discussed at a final meeting of the project partners and an IEA expert group in Korea in September, 2004. Additionally, consumer substations in the district heating system of Cheongju were visited that had been found to perform below optimum in a first assessment and had been improved during the term of the project.

Your contact

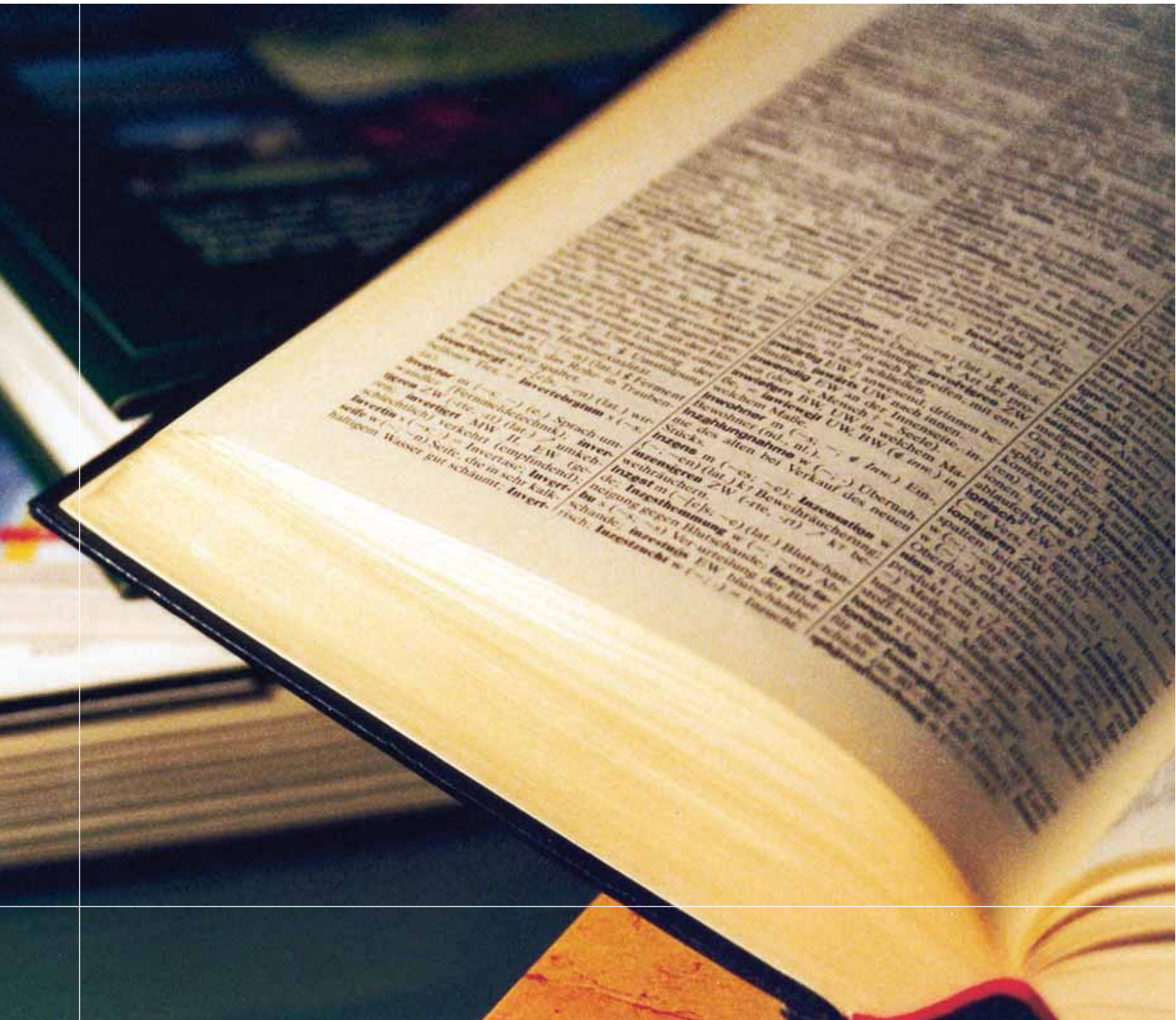
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Customer substation in Cheongju, Korea

"A book is like a garden
carried in a pocket."

[Arabian proverb]



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Publications

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Patents

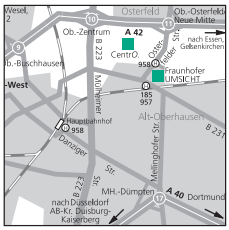
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Publications

The following survey only includes lectures and publications which were written and/or delivered in English. For a complete bibliography, see the German version of our annual report.

Publications

Bertling, J.; Blömer, J.; Kümmel, R.:
Hollow micro spheres
In: Chemical Engineering and Technology 27 (2004), no. 8, p. 829-837

Blömer, J.; Bertling, J.:
Hollow micro spheres
(International Congress for Particle Technology (PARTEC) <2004, Nürnberg>)
In: Pratsinis, S. E.; NürnbergMesse GmbH: PARTEC 2004, International Congress for Particle Technology. Proceedings. CD-ROM: Nuremberg, Germany, 16-18 March 2004 Nuremberg: NürnbergMesse GmbH, 2004

Borga, A.*; Ramos, H.*; Covas, D.*; Dudlik, A.; Neuhaus, T.:
Dynamic effects of transient flows with cavitation in pipe systems
(International Conference on Pressure Surges <9, 2004, Chester>)
In: Murray, S. J.; BHR Group, Cranfield/Bedford: The practical application of surge analysis for design and operation. Vol. 2: Papers presented at 9th International Conference on Pressure Surges, Chester, UK, 24-26 March 2004 Cranfield: BHR Group, 2004, p. 605-617 (Transferring technology)
*Civil Engineering Department, Lisboa

Dörmö*, N.; Bélafi-Bakó, K.*; Bartha, L.*; Ehrenstein, U.; Gubicza, L.*:
Manufacture of an environmental-safe biolubricant from fusel oil by enzymatic esterification in solvent-free system
In: Biochemical Engineering Journal 21 (2004), p. 229-234
*Research Institute for Chemical and Process Engineering, University of Veszprém, Hungary

Dudlik, A.; Schoenfeld, S. B. H.; Hagemann, O.*; Car, H. M.*; Prasser, H.-M.*:
Water hammer and condensation hammer scenarios in power plants (pps) using new measurement system
Proceedings of 9th International Conference on Pressure Surges, Part I, Chester, UK 151-165
*Forschungszentrum Rossendorf

Dudlik, A.; Schoenfeld, S. B. H.; Hagemann, O.*; Neuhaus, T.; Prasser, H.-M.*:
Pressure surges in process plant pipe systems
(International Symposium Loss Prevention and Safety Promotion in the Process Industries (LP) <11, 2004, Praha>)
In: Pasman, H. J.; Czech Society of Chemical Engineering: Loss prevention 2004: 11th International Symposium Loss Prevention and Safety Promotion in the Process Industries, LP 2004, 31 May - 3 June 2004, Praha, Czech Republic; paper full texts
Prague: PCHE PetroChemEng, 2004, p. PG337
*Forschungszentrum Rossendorf

Falk, K.*; Bergant, A.**; Dudlik, A.; Neuhaus, T.; Murray, S. J.***; Pothof, I.****; Hunt, S.*****:
Multi-phase effects on pressure surges
(International Conference on Pressure Surges <9, 2004, Chester>)
In: Murray, S. J.; BHR Group, Cranfield/Bedford: The practical application of surge analysis for design and operation. Vol. 2: Papers presented at 9th International Conference on Pressure Surges, Chester, UK, 24-26 March 2004 Cranfield: BHR Group, 2004, p. 661-672 (Transferring technology)
*ABB Offshore Systems, Norway
**Litostroj E. I. d. o. o., Slovenia
***Atkins Process, UK
****WL/Delft Hydraulics, The Netherlands
*****Hydraulic Analysis, UK

Larsen, H. V.*; Wigbels, M.; Bøhm, B.**:
A comparison of aggregated models for simulation and operational optimisation of district heating networks
In: Energy conversion and management 45 (2004), no. 7-8, p. 1119-1139
*Department of Systems Analysis, Risø National Laboratory, Denmark
**Department of Mechanical Engineering, Technical University of Denmark

Neuhaus, T.; Dudlik, A.; Fahlenkamp, H.*:
Examination of numerical methods and physical modelling of condensation induced water hammer including gas release
(International Conference on Pressure Surges <9, 2004, Chester>)
In: Murray, S. J.; BHR Group, Cranfield/Bedford: The practical application of surge analysis for design and operation. Vol. 2: Papers presented at 9th International Conference on Pressure Surges, Chester, UK, 24-26 March 2004 Cranfield: BHR Group, 2004, p. 569-580 (Transferring technology)
*University of Dortmund

Schoenfeld, S. B. H.; Dudlik, A.; Schlüter, S.; Neuhaus, T.; Prasser, H.-M.*:
Pressure surges in pipe systems: Impact on plant safety, detection, analysis and prevention methods
(European Safety Management Group (International Symposium) <2004, Nuremberg>)
In: European Safety Management Group -ESMG-, Hamm: Process safety and industrial explosion protection: International ESMG symposium, Nuremberg, Germany, 16-18 March 2004 Hamm: ESMG, 2004, 12 p.
*Forschungszentrum Rossendorf

Seydel, P.; Sengespeick, A.; Blömer, J.; Bertling, J.:
Experiment and mathematical modelling of solid formation at spray drying
In: Chemical Engineering and Technology 27 (2004), no. 5, p. 505-510

Seydel, P.; Blömer, J.; Bertling, J.:
Modelling particle morphology at spray drying using population balances
(2nd International Conference on population balance modelling – PBM 2004 – < 2004, Valencia>)
In: 2nd conference on population balance modelling – PBM 2004

Unger, A.*; Eisbein, M.**; Jelen, E.; Berger, T.***; Gockel, F.***:
Gentle decontamination of art treasures
In: Focus on gas – Reports on research and technology (2004), no. 22, p. 21-25
*Rathgen-Forschungslabor, Berlin
**Landesamt für Denkmalpflege Sachsen, Dresden
***Messer Griesheim, Krefeld

Weber, A.*; Kümmel, R.; Kraska, T.**:
Investigation and modelling of the gas-antisolvent process
In: Brunner, G.: Supercritical fluids as solvents and reaction media
Amsterdam: Elsevier, 2004, p. 429-448
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IMBIGS Institute of Mechanized Construction & Rock Mining, Center of Waste Management, Katowice, Poland
IMM Institut für Mikrotechnik GmbH, Mainz
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INEOS Phenol GmbH & Co. KG, Gladbeck
Infracor Logistik und Beschaffung Degussa-Hüls-Gruppe, Marl
Innoterm Energetics Ltd., Budapest, Hungary
Innovatherm GmbH, Lünen
Institut für Abfall, Abwasser und Infrastruktur-Management GmbH, Ahlen
Institut für Energetik GmbH, Leipzig
Institut für ökologische Wirtschaftsforschung GmbH, Berlin
Institut für Verfahrenstechnik und Dampfkesselwesen, Stuttgart
IZES – Institut für ZukunftsEnergieSysteme an der Hochschule für Technik und Wirtschaft, Saarbrücken
Institute for Environmental Science and Engineering, Singapore
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iSi Airbag GmbH, Vienna, Austria
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IUTA, Institut für Energie- und Umwelttechnik e. V., Duisburg
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IZES Institut für Zukunftsenergiesysteme, Saarbrücken

J

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WS Wärmeprozesstechnik GmbH, Renningen
Wolfgang Thaler, Kempen
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Wuppertaler Stadtwerke AG, Wuppertal
Wupperverband für Wasser, Mensch und Umwelt, Wuppertal

Z

ZERMA Zerkleinerungsmaschinenbau GmbH, Sinsheim-Dühren
Zeppelin Baumaschinen GmbH, Friedrichshafen
Zott GmbH & Co. KG, Mertingen
ZSW Zentrum für Sonnenenergie- und Wasserstoff-Forschung, Stuttgart
ZW Energiteknik AG, Nyköping, Sweden
Zweckverband Abfallbehandlung Kahlenberg, Ringsheim

Patents

Patents 2004

Issued Patents:

Illuminating apparatus comprising a device for protection against electric discharges and method for protection against electric discharges in lighted lamps (Özgüc; Seifert; Heil; Gerigk) – Germany

Demonstration device modeling a living organism (Weinspach) – Israel, Brazil, China, Hungary

Method for extracting solid substances from solutions (Kümmel, Robert, Hamatschek*) – Europe

Ice generator for the production of an aqueous ice-crystal suspension (Dötsch) – Europe

Arrangement for avoiding a cavitation peak during fast closing of a pipeline for transportation of a fluid (Schlüter, Dudlik, Prasser*) – Europe

Device for avoiding unwanted pressures in a pipeline when shutting off or throttling the fluid supply (Prasser*, Schlüter, Dudlik) – Europe

Method and installation for the combined generation of power, heat and/or cold from pollutant-laden hot gases with integrated gas purification (Heinz, Unger, Noeres) – Germany

* = external inventors

Registered trademarks:

LANrunner® (word trademark)

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Glass Giant® (US word trademark)

Bio-raffiniert® (word/symbol trademark)

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Spin-offs

Spin-offs

AIROX GmbH, Alpen
Systems for oxygenation

Andreas Schröder IT-Consulting GmbH, Schermbeck
Counseling and service in the area of information and telecommunication technologies

A-TEC Anlagentechnik GmbH, Duisburg
Innovative solutions concerning coal mine gas; hazard prevention: analyses, extraction, safety concepts; utilization for power and heat generation: energy concepts, design and operation of plants

DataPool Engineering GmbH, Oberhausen
Software development, system analyses, EDP-consulting

Emissions-Trader ET GmbH, Alpen
Emissions trading

ENR – Energiegesellschaft nachwachsender Rohstoffe mbH, Dorsten
Planning and set-up of biogas plants, including consulting, concession, and funding; agricultural nutrient balances and area management; commissioning and management

FKuR Kunststoff GmbH, Willich
Innovative solutions concerning plastics and recycling; comminution technology; extrusion, injection molding; elastomer recycling; material analyses; test technology; recycling concepts

gct german carbon teterow GmbH, Teterow
Development and production of high-performance cylindrical activated carbon; production of special activated carbons; development of adsorption processes

IDESYS Ingenieurgesellschaft für dezentrale Energiesysteme mbH, Oberhausen
Planning, development, production, installation of local energy systems and plants

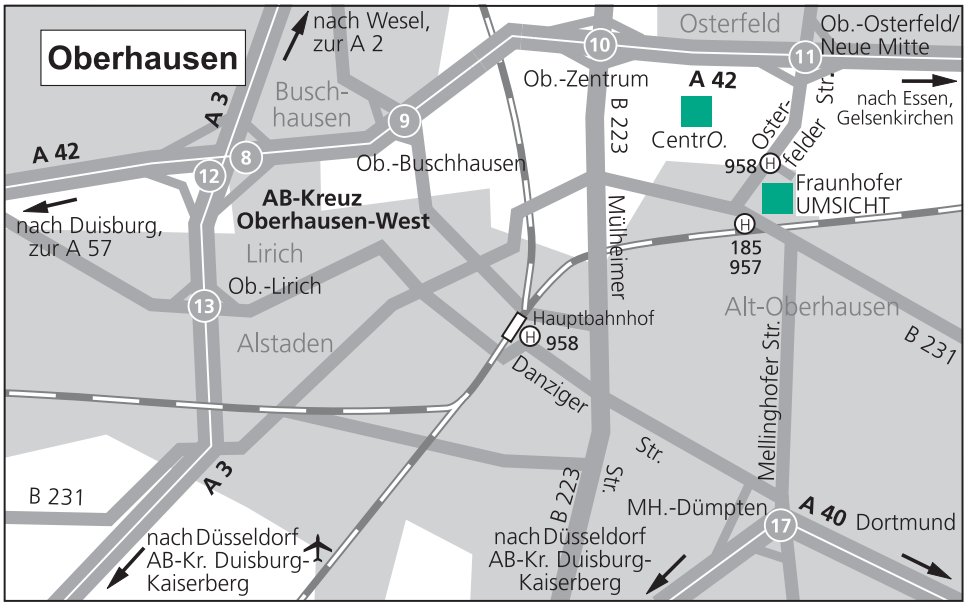
inecs GmbH, Dortmund
Innovative energy technology, consulting & systems, fuel cell systems

invenio KUNSTSTOFF ENGINEERING, Erwitte
Product development and optimization of plastics components with numerical analyses; FEM structure analyses, injection molding analyses; construction

VENTAX Big-Bag Network GmbH & Co. KG, Willich
Big-Bag cleaning facilities, reusable Big-Bag, packaging systems

WAGRO Systemdichtungen GmbH, Dortmund
Swellable polymere seals; sewer and building refurbishment; consultation, planning, and implementation; development and production of sealing systems (area of application: engineering and pipeline construction)

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Exit Oberhausen-Osterfeld/Neue Mitte. Go straight forward onto Osterfelder Strasse. Follow Osterfelder Strasse towards "Neue Mitte Oberhausen" or "Oberhausen-Zentrum/Essen" respectively. After approximately 1.5 kilometers (behind the sign "Fraunhofer UMSICHT") turn left on the institute's parking lot.

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By train

From Oberhausen-Hbf. either with bus number 958 (towards Spechtstrasse), 957 (towards Kiebitzstrasse) or 185 (towards Essen Borbeck Bf.), exit at the stop "UMSICHT".

By plane and train/car

From Düsseldorf Airport terminal A/B/C take the Skytrain to Düsseldorf Airport Station, then change to the Regional Express to Hamm or Wesel respectively. Leave the train at Oberhausen central station;
to continue see: By train or if you are traveling by car take Freeway A 44 from the airport till you reach intersection "Düsseldorf-Nord". Take freeway A 52 (direction Essen/Oberhausen). At intersection "Breitscheid" change onto freeway A 3 and keep going until you get to intersection "Oberhausen West"; From there turn onto freeway A 42 (direction "Dortmund") and take the exit "Oberhausen-Osterfeld/Neue Mitte"; to continue see: by car.

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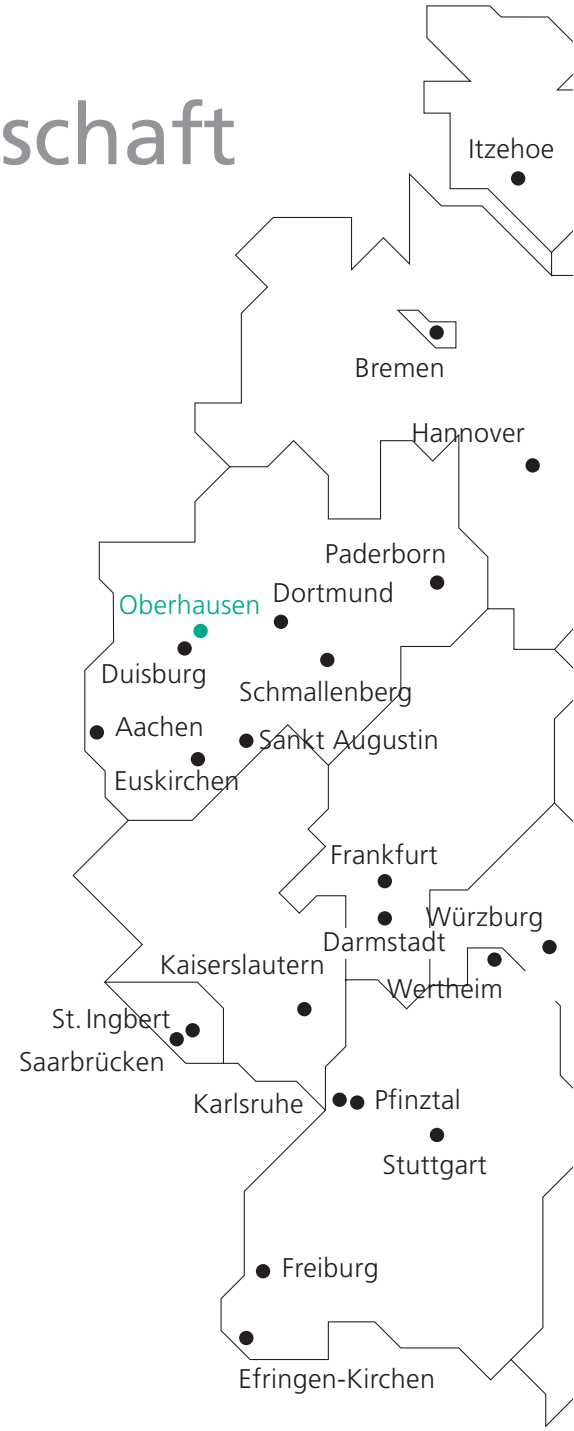
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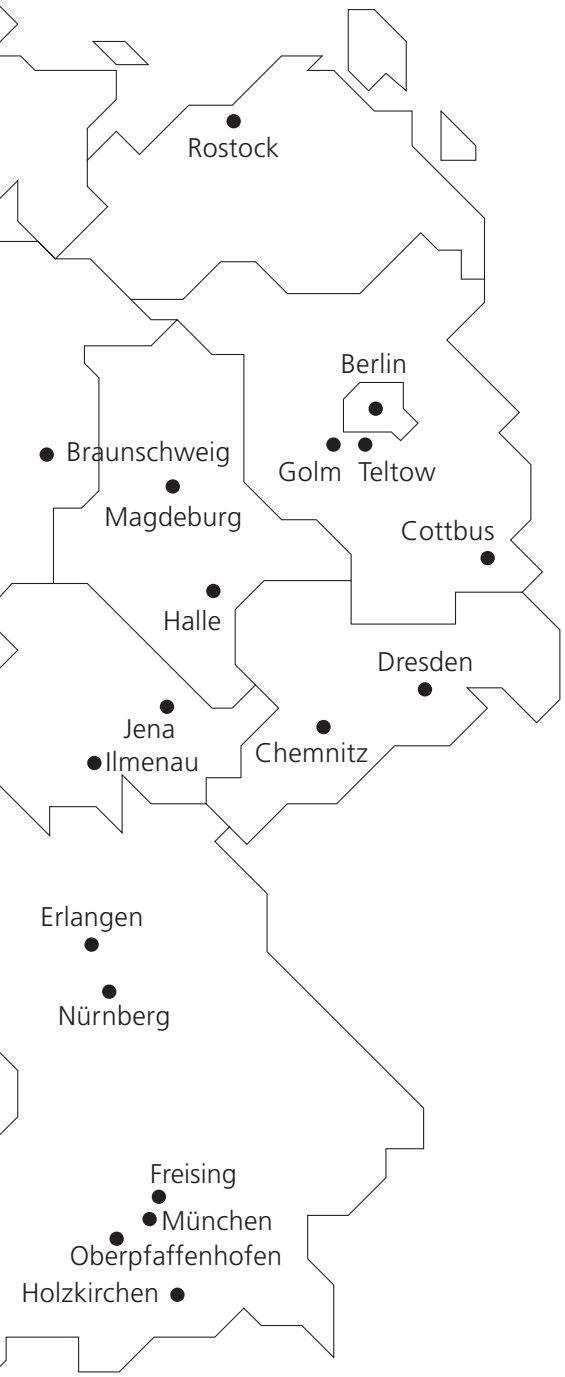
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