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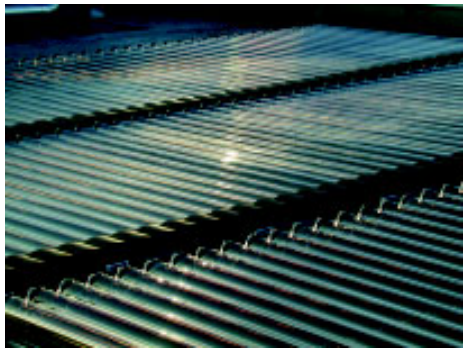
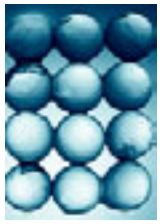
Fraunhofer Institut
Umwelt-, Sicherheits-,
Energietechnik UMSICHT

Annual Report 2001



The Department of
Environmental Technology
comprises the areas of expertise



- New Processes
- Particle Technology
- Adsorption/Gas Cleaning
- Waste Technology and Management
- Plastics Technology
- Bioengineering
- Water Treatment/Membrane Technology
- Special Polymeres
- Chemistry, Biology, Analytics

The Department of
Safety and Process Technology
comprises the areas of expertise

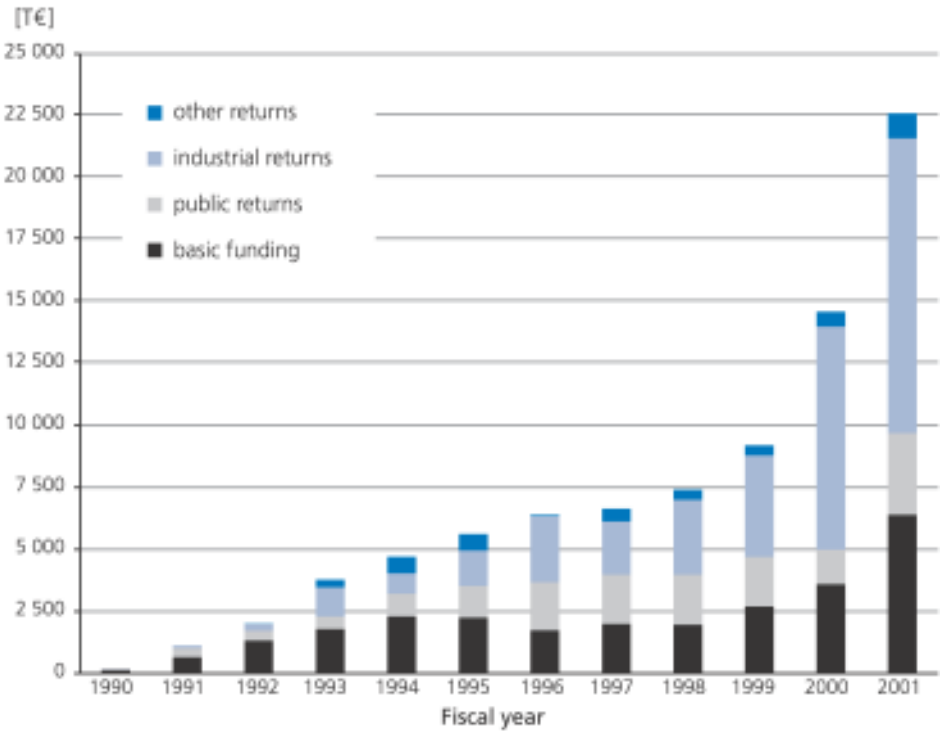
- Safety Analysis and Design
- Dynamic Processes
- Software Development
- Fire Safety and Explosion Protection
- Technical Information Management
- Pipeline Technology

The Department of
Energy Technology
comprises the areas of expertise

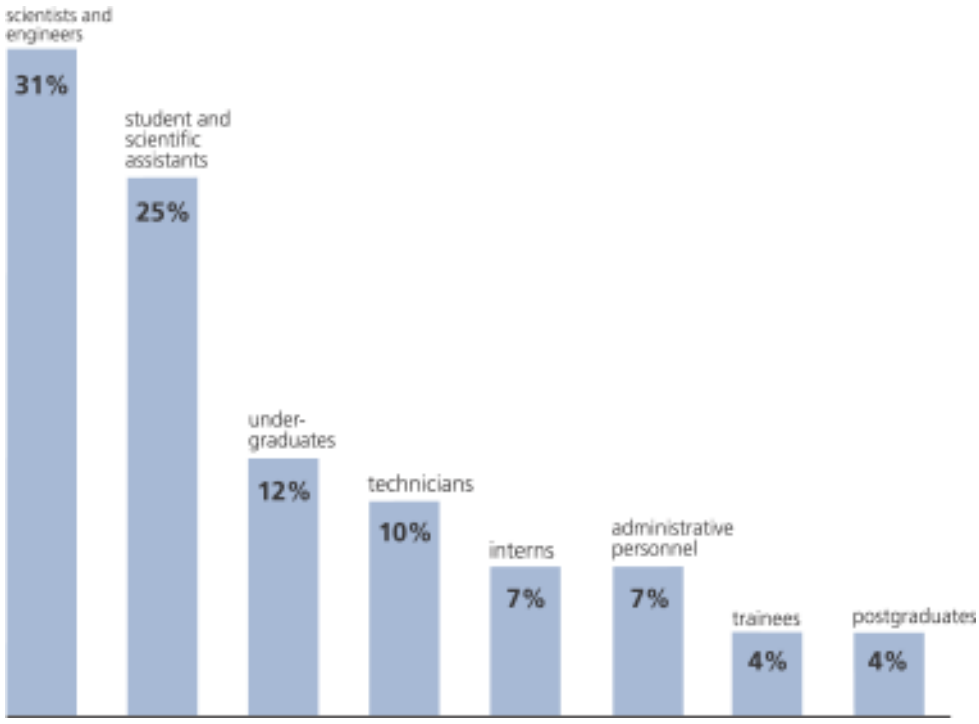
- Use of Lean Gas
- District Heating/Combined Heat and Power
- Cold Supply
- Energy Management
- Energy from Biomass
- Fuel Cell Systems
- Plant Systems Engineering

The Department of
Knowledge and Technology Transfer
comprises the areas of expertise

- International Project Development
- Training Center
- Project Funding/Spin-offs



Development of the operational budget over the past 12 years



Structure of staff at Fraunhofer UMSICHT

Staff

Staff at Fraunhofer UMSICHT in 2001	Number
Permanent Staff	**138**
- Scientists and engineers	89
- Technical infrastructure	28
- Central services	21
Other Staff	**147**
- Postgraduates	11
- Undergraduates	35
- Student assistants	72
- Interns, guest scientists	19
- Trainees	10
Total Staff	**285**

Expenditure and Returns

Expenditure 2001	(Mio. €)
Operational Budget	22,6
- Staff costs	8,4
- Other costs	14,2
Investments	4,6

Returns Operational Budget 2001	(Mio. €)
- Industrial Returns	11,9
small and medium-sized enterprises	9,8
major enterprises	2,1
- Public Returns	3,3
- Other (EU, communities)	1,0
- Basic Funding	6,4
Total Returns	22,6

Preface

”Fantasy is more important than knowledge for knowledge is limited”: With these words by Albert Einstein did I inaugurate the first “Fall Meeting” of the Fraunhofer-Regional-Initiative NRW with Ministries from North-Rhine Westphalia at Gelsenkirchen-Horst castle.
What caused lively discussions then is at the same time motto for the work of Fraunhofer UMSICHT: Moving borders with fantasy and developing ideas for new technologies and services.

The institute´s employees heed to this motto in a remarkable way: 2001 was a very successful year in our still young history. Our turnover has increased by 50% – more than € 22 Mio – compared with the previous year. This verifies impressively the part that the institute plays on the research and development market and in the region.

I consider the wide range of our project partners, friends, and supporters as further evidence of the above, and would like to thank them for their trust in our work. Especially small and medium-sized enterprises accept and demand our innovations stronger than ever.
This is primarily my employees´ profit whom I would like to thank for their performance and creativity. Their dedication to convert results of applied research and development into practice is exceptional.

In 2001, many development lines came to force: A biogas plant fed with liquid manure was put into operation. Since then it has not only produced power and heat, but also cold. On the company´s premises the first sod was turned for the construction of a modular co-generation plant which will be run with coal

mine gas. After a development period of six years, we are now in negotiations about a first demonstration plant for the thermal combustion of biomass. Membrane plants gain reusable material in dairy businesses and combine economics and environmental protection.

The *O*.vision theme park – a popular combination of entertainment, technological progress, and economy which is to be realized on a 65 hectare area in Oberhausen – links 8 Fraunhofer institutes under the coordination of Fraunhofer UMSICHT at the moment. And 100 new enrolments speak for the attractiveness of the further education program "infernum".

In many, partly still highly speculative, research projects lies the potential for the "innovation of tomorrow": A mobile pilot plant station for the treatment of waste material, bio-degradable polymers, the experimental testing of smoke extraction systems, or information and communication technologies for the process technology are examples I consider as highly attractive.

Scientific and economic progress fill us with enthusiasm to set strategic emphasis in the coming years, but as well to expand our thematic research and develop-ment variety. That way the institute is well positioned to move borders with fantasy into new directions.

With kindest regards

Yours

Hans Fahlenkamp
Director Fraunhofer UMSICHT

In February, Gabriele Behler, NRW-Minister of Science, presented Prof. Dr. Klaus Görner (University of Essen), and Prof. Dr. Hans Fahlenkamp (University of Dortmund) (f. l. t. r.) with an award for future-oriented top-class research

In April, Dr. H. Ringstorff, Minister-President of a Federal German state, and Dr. R. Dettmann, Mayor of Teterow, layed the foundation stone for the German Carbon Teterow GmbH (Fraunhofer UMSICHT spin-off)

Highlights 2001

Lünen-Brambauer in June: Official inauguration of the largest coal mine gas plant in the Ruhr area on the premises of the shut down coal mine "Minister Achenbach"

Turning the first sod in October: Official opening of the construction work for a fuel cell co-generation plant for combined heat, cold, and power generation on the premises of Fraunhofer UMSICHT

Highlights 2001

In October: First "Fall Meeting" of the Fraunhofer regional initiative at Gelsenkirchen-Horst castle, with the North-Rhine Westphalian Ministries MSWF, MWMEV and MASQT

State Secretary Jörg Hennerkes (MWMEV) started a biogas plant on the Loick farm in Dorsten-Lembeck in September

Oberhausen-based Minister of Environment Bärbel Höhn had her "home match" during the 2001 Coal Mine Gas Days

Technology that pays

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.

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

Fraunhofer UMSICHT

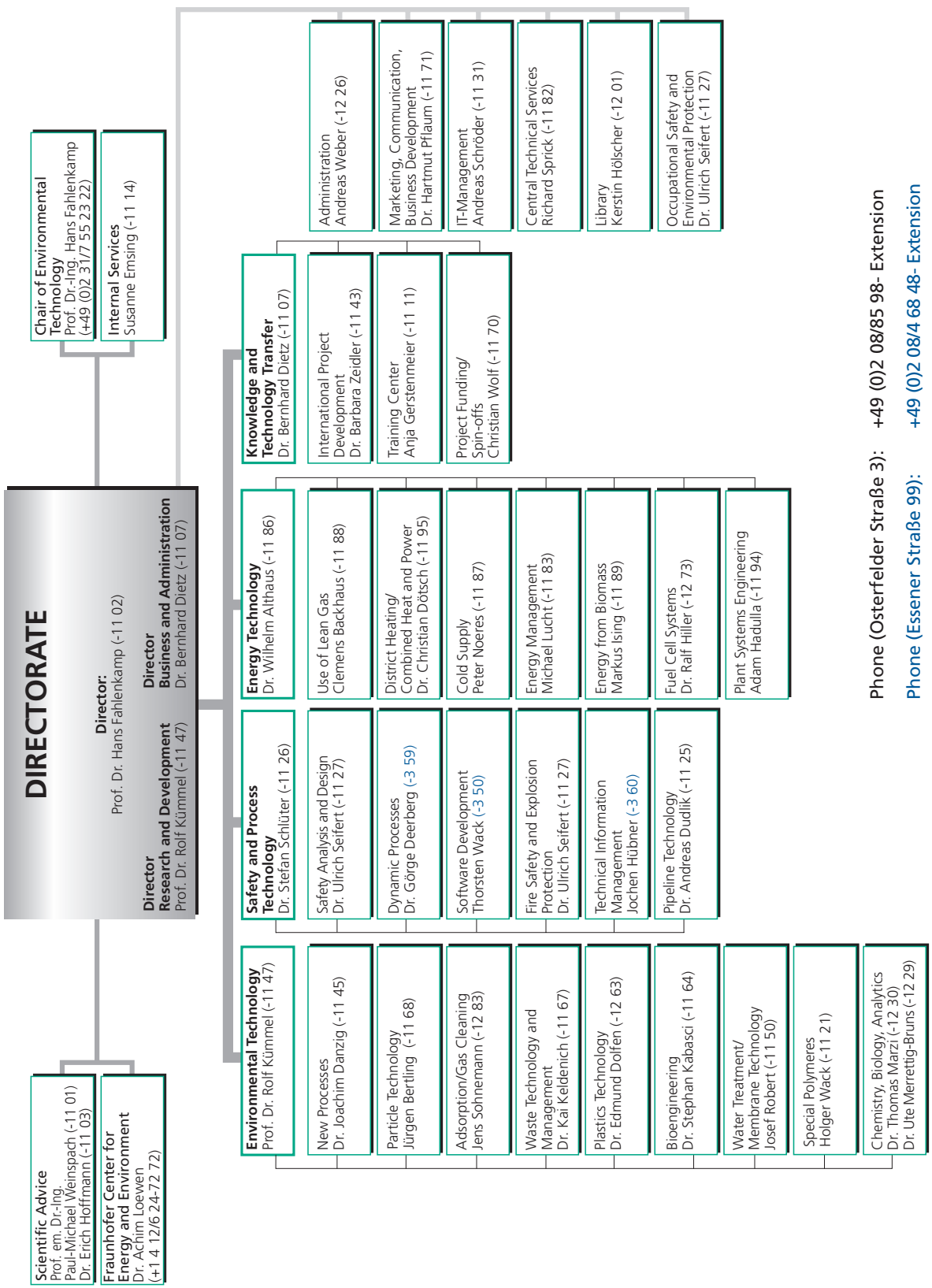
Which makes apparent: Technological progress is the engine for every modern industrial society. Technological innovations help making efficient and safe use of resources and energy resources. They allow a satisfactory and inexpensive production of innovative goods, create, and secure competitive jobs.

In this context, Fraunhofer UMSICHT develops, tests, evaluates, and optimizes technical processes as a catalyst for science and economy. In cooperation with industrial and public partners, state of the art findings are being transfered into marketable technologies, products, and services.

The business segments environmental technology, safety and process technology, as well as energy technology stand for application-oriented, procedural know-how: from first feasibility and profitability studies, over sophisticated simulation programs, to demonstration plants in production scale. Innovation management, on-the-job training, and project development and financing round off the profile. Internationally, the institute is represented in the U.S., states of central- and Eastern Europe, and Latin America.

Fraunhofer UMSICHT in Oberhausen is located in the vicinity of the shopping and recreation center Centr*O*. and adjacent to the planned *O*.vision future theme park. It has more than 200 employees who produced a turnover of more than 22 Mio € in 2001. About 75% of which stem from mission-oriented research, and more than 50% alone from the economy.
Fraunhofer UMSICHT engages in the structural change in Oberhausen and in the region with new ideas, technology transfer, spin-offs, and the formation of research and development networks.

Organizational Chart



Competencies

Six areas of expertise are the basis for the process-technological operation in the business segments. They find application in the thematic and cross-sectional areas of expertise.

Main Areas of Expertise

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

Departments

Department of Environmental Technology

Head: Prof. Dr. rer. nat. Rolf Kümmel
Phone: +49 (0) 2 08/85 98 -11 47
rolf.kuemmel@umsicht.fhg.de

New Processes

Analysis of conventional production processes; development of low-emission syntheses; crystallization by means of supercritical fluids; microreaction technology
Contact: Dr. rer. nat. Joachim Danzig
Phone: +49 (0) 2 08/85 98 -11 45
joachim.danzig@umsicht.fhg.de

Particle Technology

Particle technology; crystallization processes; comminution; microencapsulation; spray drying; separation; sample processing
Contact: Dipl.-Ing. Jürgen Bertling
Phone: +49 (0) 2 08/85 98 -11 68
juergen.bertling@umsicht.fhg.de

Adsorption/Gas Cleaning

Flue gas cleaning; gas washing and adsorption; catalytic conversion of gaseous airborne contaminants; production and characterization of adsorbents; adsorber modeling
Contact: Dipl.-Ing. Jens Sohnemann
Phone: +49 (0) 2 08/85 98 -12 83
jens.sohnemann@umsicht.fhg.de

Waste Technology and Waste Management

Thermal waste treatment; waste reprocessing; waste confectioning; utilization of residues; looping; optimization of thermal processes; simulation of waste treatment processes; material flow management
Contact: Dr. rer. nat. Kai Keldenich
Phone: +49 (0) 2 08/85 98 -11 67
kai.keldenich@umsicht.fhg.de

Plastics Technology

Plastics technology; automobile recycling concepts; product development; material and recycling-oriented design; injection molding; extrusion; plastic testing technology; Finite Elements Method analyses (FEM); market and technology studies; material development/compounding; fiber-reinforced and bio-degradable materials; new areas of application
Contact: Dr.-Ing. Edmund Dolfen
Phone: +49 (0) 2 08/85 98 -12 63
edmund.dolfen@umsicht.fhg.de

Bioengineering

Synthesis of valuable materials; reprocessing of biotechnological products; modeling; biological sewage treatment, waste air, and solid waste treatment; production of biogas
Contact: Dr.-Ing. Stephan Kabasci
Phone: +49 (0) 2 08/85 98 -11 64
stephan.kabasci@umsicht.fhg.de

Water Treatment/ Membrane Technology

Development of new areas of membrane technology; linking of process water streams; reprocessing of pickling acids with membrane combined processes; filtration of sewage system discharge for the re-utilization of water
Contact: Dipl.-Ing. Josef Robert
Phone: +49 (0) 2 08/85 98 -11 50
josef.robert@umsicht.fhg.de

Special Polymeres

Temperature sensitive/hydrophilic gels; superadsorbers; thermochromates; syntheses; product characterization; analytics; application technology
Contact: Dipl.-Ing. Holger Wack
Phone: +49 (0) 2 08/85 98 -11 21
holger.wack@umsicht.fhg.de

Chemistry, Biology, Analytics

Thermal analysis; reaction calorimetry; rheological examinations; particle size distribution; testing of contaminants and summary parameters; characterization of products and residues; testing and online-analyses for pro-cessing systems; biological testing processes; analysis of organic materials; isolation of combined and pure-culture microorganisms; determination of combustion products
Contact: Dr. rer. nat. Thomas Marzi
Phone: +49 (0) 2 08/85 98 -12 30
thomas.marzi@umsicht.fhg.de
Contact: Dr. rer. nat. Ute Merrettig-Bruns
Phone: +49 (0) 2 08/85 98 -12 29
ute.merrettig-bruns@umsicht.fhg.de

Department of Safety and Process Technology

Head: Dr. -Ing. Stefan Schlüter
Phone: +49 (0) 2 08/85 98 -11 26
stefan.schlueter@umsicht.fhg.de

Safety Analysis and Design

Safety of plants and plant components; transport and storage safety; safety analysis in compliance with German regulations; thermal analyses
Contact: Dr.-Ing. Ulrich Seifert
Phone.: +49 (0) 2 08/85 98 -11 27
ulrich.seifert@umsicht.fhg.de

Dynamic Processes

Pattern recognition; process control system protection and mitigation planning; model-based measuring methods; simulation of plants and scheduling of production processes; layout/evaluation of ethoxylation processes; application of commercial simulation software
Contact: Dr.-Ing. Görge Deerberg
Phone: +49 (0) 2 08/4 68 48 -3 59
goerge.deerberg@umsicht.fhg.de

Software Development

GUI (graphical user interface) for Windows NT and X Windows systems; database technologies; client-server solutions; generic systems; software design
Contact: Dipl.-Phys. Thorsten Wack
Phone: +49 (0) 2 08/4 68 48 -3 50
thorsten.wack@umsicht.fhg.de

Fire Safety Engineering, Fire and Explosion Protection for Technical Plants

Fire safety concepts for buildings; material behavior (e.g. building materials, hazardous substances); fire and explosion precaution policies for technical plants; consulting for fire brigades
Contact: Dr.-Ing. Ulrich Seifert
Phone: +49 (0) 2 08/85 98 -11 27
ulrich.seifert@umsicht.fhg.de

Technical Information Management

Information management for system security and process technology; advice concerning the state of techno-logy; support in legal permission procedures; graphically supported and dialog-based guidelines; full-text information systems; e-commerce solutions
Contact: Dipl.-Ing. Jochen Hübner
Phone: +49 (0) 2 08/4 68 48 -3 60
jochen.huebner@umsicht.fhg.de

Pipeline Technology

Pipeline test area (temperature to 200°, pressure to 80 bar); water and cavitation hammer; design of pipeline systems
Contact: Dr.-Ing. Andreas Dudlik
Phone: +49 (0) 2 08/85 98 -11 25
andreas.dudlik@umsicht.fhg.de

Department of Energy Technology

Head: Dr.-Ing. Wilhelm Althaus
Phone: +49 (0) 2 08/85 98 -11 86
wilhelm.althaus@umsicht.fhg.de

Use of Lean Gas

Coal Mine Gas (CMM), landfill gas, biogas, hazardous gases; thermal utilization concepts; burner technology, emission control
Contact: Dipl.-Ing. Clemens Backhaus
Phone: +49 (0) 2 08/85 98 -11 88
clemens.backhaus@umsicht.fhg.de

District Heating/ CHP (Combined Heat and Power Generation)

Generation, distribution of heat, network concepts, GIS, leakage localization, energy supply concepts, solar/ geothermal energies, local heating, refrigerants (ICE Slurry), expert reports, energy trading, efficiency, energy policies
Contact: Dr.-Ing. Christian Dötsch
Phone: +49 (0) 2 08/85 98 -11 95
christian.doetsch@umsicht.fhg.de

Cold Supply

Cold supply technologies, steam jet refrigeration plants, cold storage and distribution, air conditioning techniques; combined heat, cold and power generation (CHPC), solar thermal refrigeration, energy supply concepts
Contact: Dipl.-Ing. Peter Noeres
Phone: +49 (0) 2 08/85 98 -11 87
peter.noeres@umsicht.fhg.de

Energy Management

Energy management, energy trading, power plant planning, optimized co-generation, IT solutions for energy networks (consulting and implementation)
Contact: Dipl.-Ing. Michael Lucht
Phone: +49 (0) 2 08/85 98 -11 83
michael.lucht@umsicht.fhg.de

Energy from Biomass

Re-utilization concepts, power generation, combustion, gasification, gas generation using fluidized bed combustion (FBC), hot gas and tar analytical testing
Contact: Dipl.-Ing. Markus Ising
Phone: +49 (0) 2 08/85 98 -11 89
markus.ising@umsicht.fhg.de

Fuel Cell Systems

Fuel cell systems: PEFC, MCFC, SOFC; regenerative gases, gas separation techniques, system modeling and analysis; flue bed combustion, computational fluid dynamics (CFD)
Contact: Dr.-Ing. Ralf Hiller
Phone: +49 (0) 2 08/85 98 -12 73
ralf.hiller@umsicht.fhg.de

Plant Systems Engineering

Process control and visualization, planning, construction and operation of pilot and demonstration plants, heating, refrigerating and air conditioning technologies
Contact: Dipl.-Ing. Adam Hadulla
Phone: +49 (0) 2 08/85 98 -11 94
adam.hadulla@umsicht.fhg.de

Department of Knowledge and Technology Transfer

Head: Dr.-Ing. Bernhard Dietz
Phone: +49 (0) 2 08/85 98 -11 07
bernhard.dietz@umsicht.fhg.de

International Project Development

Head office of the German-Polish research association INCREASE; cooperation in the North Rhine-Westphalian action program for the promotion of external trade with central and Eastern European countries CEEC, scientific alliances and business co-operation, consulting services to central and Eastern European countries, European Union projects
Contact: Dr.-Ing. Barbara Zeidler
Phone: +49 (0) 2 08/85 98 -11 43
barbara.zeidler@umsicht.fhg.de

Training Center

Knowledge, know-how and expertise transfer; distance studies program Environmental Sciences (infernum); networking programs with schools, universities and private enterprises, vocational training programs; customized courses for industry; multi-media learning; seminars, workshops, courses
Contact: Dipl.-Ing. Anja Gerstenmeier
Phone: +49 (0) 2 08/85 98 -11 11
anja.gerstenmeier@umsicht.fhg.de

Project Funding, Spin-offs

Combined and single project funding, implementation of pilot and demonstration projects, financial support, consulting services to spin-off enterprises, finding business partners
Contact: Dipl.-Ing. Christian Wolf
Phone: +49 (0) 2 08/85 98 -11 70
christian.wolf@umsicht.fhg.de

Administration

Human resources; project monitoring; research contracts; budgeting; purchasing; accountancy; business trips; infrastructure, controling
Contact: Dipl.-BW Andreas Weber
Phone: +49 (0) 2 08/85 98 -12 26
andreas.weber@umsicht.fhg.de

Marketing, Communication, Business Development

Innovation management, market surveys and technology studies, project development, marketing concepts, distribution, business field policies, strategic planning, industrial property rights, public relations, composition and layout of print media, media work, information medium internet
Info: Dr.-Ing. Hartmut Pflaum
Phone: +49 (0) 2 08/85 98 -11 71
hartmut.pflaum@umsicht.fhg.de
Contact: Dipl.-Chem. Iris Kumpmann
Phone: +49 (0) 2 08/85 98 -12 00
iris.kumpmann@umsicht.fhg.de

IT-Management

Support of the IT structure, user help desk, high-efficient servers and services, software design, installation and support of LAN and WAN, development of web applications, training of IT specialists, assistance in IT-specific problems
Contact: Dipl.-Ing. Andreas Schröder
Phone: +49 (0) 2 08/85 98 -11 31
andreas.schroeder@umsicht.fhg.de

Central Technical Services

Project management; basic and detail engineering; sampling, analytical testing and pilot programs, technical services, central implementation of measurement and control and PLS (process control systems), internal technical services, mechanics and electric workshops, construction of demonstration and pilot plants
Contact: Dipl.-Ing. Richard Sprick
Phone: +49 (0) 2 08/85 98 -11 82
richard.sprick@umsicht.fhg.de

Library

Information systems, online literature research, document supply, Fraunhofer Publica updating, UMSICHT newsletters
Contact: Dipl.-Bibl. Kerstin Hölscher
Phone: +49 (0) 2 08/85 98 -12 01
kerstin.hoelscher@umsicht.fhg.de

Occupational Safety and Environmental Protection

Coordination and advice in topics related to occupational safety; vocational training and on-the-job courses, registration and notification procedures, monitoring of legislative regulations; safety-relevant instruction to the staff
Contact: Dr.-Ing. Ulrich Seifert
Phone: +49 (0) 2 08/85 98 -11 27
ulrich.seifert@umsicht.fhg.de

Fraunhofer Center for Energy and Environment

Development of Fraunhofer technologies for the U.S. market: process water treatment and sewage, power generation from biomass, integrated energy supply concepts
Contact: Dr.-Ing. Achim Loewen
Phone.: +1 4 12/6 24 -72 72
loewen@engrng.pitt.edu

Laboratories and Workshops

Analytical Laboratory

The analytics laboratory focuses on environmental problems, performing analyses on solid materials, gaseous and aqueous samples as well as on materials from process engineering plants. Our current work encompasses the analysis of soil, dust and waste through sewage sludge and waste water to landfill and purification gases. Where no standard analytical procedures exist, the lab team develops new methods and applications tailored to specific needs such as pilot tests. The staff also provides consulting to customers in the planning and evaluation of examinations. Our objective is the development of comprehensive solutions to technological problems using analytical measuring methods.

Special emphasis is placed on the analysis of combustion and decomposition processes and the identification of siloxanes in sewage and landfill gases. Further areas of expertise are the detection of isomers of DDT, PCP and HCH in highly contaminated wood materials.

Among others, the range of the analyzed standard parameters includes:

Inorganic substances

- anions and cations
  - quantitative and qualitative analyses of heavy metals and anions
- summary parameters
  - total nitrogen (Kjeldahl)
  - organic and inorganic carbon dioxide (TOC; TIC)
  - water hardness
  - acid and base capacity
  - surface-active agents (MBAS, BIAS)

Organic substances

- hydrocarbons
  - aliphatic hydrocarbons
  - benzene, toluene, xylenes (BTX)
  - polycyclic aromatic hydrocarbons
  - various solvents
- halogenated hydrocarbons
  - pentachlorphenole (PCP)
  - γ-hexachlorocyclohexane (HCH) and other isomers
  - high volatile chlorinated hydrocarbons
- GC-MS-screenings

Physical-chemical analytical measurements

- analyses of chemical reactions in reaction calorimetries
- thermal analyses
- rheological analyses
- laser-optical determination of particle sizes in solid materials
- analyses of combustion and degradation reactions (also equipment according to DIN 534 36)
- BET-surface analyses
- pore volume investigations

Equipment (selected)

- gas chromatographs including mass spectrometer GC-MS
- high performance liquid chromatograph
- atomic emission spectrometer including inductively coupled plasma as initiating unit (ICP-AES)
- reaction calorimeter (RC1) including 2-litre reactor, temperature range 0 °C to 200 °C, 0 to 50 bar excess pressure
- thermal analysis system for combined thermal gravimetry (TG) and differential thermal analyses (DTA or DSC), temperature range from -150 °C to 1500 °C
- rheometer, regulated by shearing stress with air bearing technology
- equipment for laser optical particle size analysis (3-laser-technique, size range 0.1 to 700 µm)
- ion chromatograph (IC)
- graphite tube atomic adsorption spectrometer (AAS)
- BET-surface analysis equipment
- solid and liquid matter TOC
- mercury porosimeter

Laboratories and Workshops

Biotechnological Laboratory

The biotechnological lab specializes in solutions for the clarification of contaminated media (soil, water, air) performing analyses on potentials of inherent biodegradability and biological production and developing novel microbiological processes in laboratory and technical scales.

New biotechnological methods and systems are developed, designed and tested step by step in order to ensure technical feasibility at high efficiency and operational safety. In many cases, the traditional methods existing have to be completed by specific custom-made processes. In close co-operation with the analytics department and the experts from the engineering staff, the biotechnological lab advances the solution of novel and efficient solutions.

Services

- analyses of compost materials in compliance with BGK methods (Fraunhofer UMSICHT is an accredited testing laboratory of the "Bundesgütegemeinschaft Kompost e. V." (Federal association of compost quality standards))
- microbiological examinations in compliance with the DIN, ISO and OECD methods
- analyses of the biological degradability of chemical substances (aerobic and anaerobic)
- investigations on biologically degradable materials in compliance with DIN V 54900
- isolation of mixed and pure bacterial cultures with specific degradation potentials
- development of microbiological processes
- scaling-up of biotechnological processes (performance, support)
- sensitivity analyses of biotechnological processes
- consulting and analyses in hazardous incidents or optimization demand in biotechnological plants (e.g. sewage treatment or composting)
- R&D projects:
  e.g. aerobic and anaerobic treatment (fermentation or composting of organic residues)
- working license for pathogen agents in compliance with § 19 Abs.1 Nr. 2 BSeuchG of the German Federal Law on Epidemic Control

Equipment

Additionally to the standard equipment for microbiological research up to security level 2, the following instruments are available:

- bioreactors (2-20 l) with modern measuring and control equipment
- BOD-apparatus (Sapromat), inhibitor test for bioluminescent bacteria (sampling equipment for airborne organisms)
- anaerobiontes work bench involving an anaerobic breeding reactor

Laboratories and Workshops

Workshops

The workshops at the Institute are divided into

- electric and electronics workshops, and
- mechanic workshops

The service range of the electric and electronics workshops comprises the maintenance and operation of the in-house power supply system, of the technical plants and the laboratories as well as the planning and construction of new plants in the low voltage and in the high voltage range up to 1000 V, consistent with VDE guidelines. Small units ranging from measuring and control equipment, comprehensive control modules to complete measuring and control systems are developed and constructed.

Our service range includes, in addition to the design and drawing up of wiring diagrams, also the installation and implementation of structural units. Our solutions designed for internal use support the engineering and researching staff in the performance of measuring, control and monitoring works and in the delivery of innovative technology.

The manufacturing facilities offer both services in cutting production (drilling, abrading and polishing, lathe work, milling) as well as non-cutting processing (welding) of plastic materials and metals.

The workshops, thus, offer the possibility both to set up complete plants and to manufacture specific scientific instruments or custom-made analytical equipment. As a result, custom-made parts and solutions are ready for use without delay. Furthermore, small-scale serial production of work-pieces or small tools is also available.

Laboratories and Workshops

Marketing, Communication, Business Development

IT Management

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 against infringement, our department is also responsible for the registration of inventions, assistance in industrial property rights, and in license agreements.

Innovation management and marketing are no 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 relations 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 services for internal and external customers, focusing on the following areas of expertise:

- planning, continuous operation and support of the DP system
- 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 databases. 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 six trainees who are becoming IT-specialists in the fields of system integration and applications development.

Library

The in-house technical library currently comprises approx. 6,900 monographs, 91 scientific journals, 44 permanently updated loose-leaf editions, 31 information brochures (among them publications by ministries, associations, boards and organizations), and bulletins issued by government boards in various research disciplines.

In addition to literature searching through the Fraunhofer wide library data network STAR, professional literature and patent searching through online databases is available.

Additionally, research on enterprises is made available to all staff through the Hoppenstedt-database.

The service range of the library comprises the interlending of required materials on request.

The library documents and collects publications made by Fraunhofer UMSICHT scientific staff to be included into the FhG Publica, a world-wide accessible Fraunhofer database.

The responsibilities of the library include the editing of the UMSICHT publications, ranging from advisory support to the authors to the delivery of the printed copies to the Technische Informationsbibliothek (TIB, Technical Information Library) in Hanover.

Library

Fraunhofer UMSICHT offers access to the major electronic database providers (STN International, FIZ Technik, DataStar) as well as inquiries via in-house databases such as the Chemical Engineering and Biotechnology Abstracts database, supported by DECHEMA. Further online information sources are KOWI and ECHO databases, reporting continually on current and future research activities in the European Union member countries.

Occupational Safety and Environmental Protection

The work group "Occupational Safety and Environmental Protection" (AU) acts as coordinating and organizing board for issues related to occupational safety and environmental protection, through consulting of executives and staff, and through continuous promotion and upgrading of the AU-related organization. The scope of duties includes the organization and co-ordination of occupational injury prevention and health protection, emergency and risk management policies, emergency precaution, and occupational injury notification. Qualification courses and on-the-job training in the field of occupational safety are offered to AU-administrators and decision-makers.

Core projects in 2001 were:

- access safety control concept for the Institute
- management responsibility for occupational safety
- intranet information service on AU-related issues

Occupational Safety and Environmental Protection

Fraunhofer Center Pittsburgh

Fraunhofer Center for Energy and Environment, Pittsburgh

Fraunhofer UMSICHT in co-operation with IGB and the University of Pittsburgh operates the Fraunhofer Center for Energy and Environment in Pittsburgh, Pennsylvania in the U.S. Before the Center was founded in 2001, the U.S. market for environmental and energy technologies was evaluated, contacts to potential partners and customers were established, and the regional demand for the services offered by Fraunhofer UMSICHT and IGB was assessed.

The new Center serves a variety of purposes. One of them is to offer the services of Fraunhofer institutes to the U.S. market. The projects are carried out both in Germany and in America. In addition, a close tie to technological developments in the U.S. is ensured, which is supported by the co-operation with leading institutions in the Pittsburgh region. This leads to increased reputation and competence and, thus, enhances competitiveness in Germany. Furthermore, German enterprises are supported in their efforts to develop and offer products for the American market. Finally, the Center also serves as new tool in human resources development and recruitment.

Many projects of the Center are dedicated to the treatment of process and wastewater. Besides improving the environment, the recovery of valuable substances leads to economical benefits. For instance, membrane technology is employed to recover acids and metals from pickling liquors in the metal industry. Further applications for membranes are municipal sewage treatment or process water treatment in the dairy industry.

Farm in Pennsylvania

Lake in Latrobe, Pennsylvania, contaminated by mining leachate

Sampling at the Tinkers Run in Irwin, Pennsylvania

Another treatment method, offered in cooperation with the ATEC Dr. Mann GmbH, uses adsorbing agents, which are made from chemically modified agricultural wastes. First laboratory tests have proven that this technology is highly suitable for the remediation of waste water contaminated due to past mining activities. As part of the treatment scheme, valuable metals can be recovered selectively. The state of Pennsylvania estimates that due to the abandoned mine discharges more than 4,000 kilometers of its rivers are contaminated, which call for a cost effective solution to this problem.

In the field of energy technology, the center is currently evaluating the economic viability of renewable energy technologies for decentralized energy supply. Pennsylvania is a rural state characterized by agricultural and wood processing industries. Therefore, the application of technologies for the digestion and gasification of biomass such as liquid manure or waste wood represents great potential for the area. A pilot project based on a small town will be carried out to assess which energy generation and utilization technologies are best suited to cover the demand for electricity, heat and cold using local resources in an environmentally sound way. For instance, the energetic utilization of liquid manure could be a cost efficient way to eliminate odor and groundwater contamination problems associated with the spreading of manure on fields.

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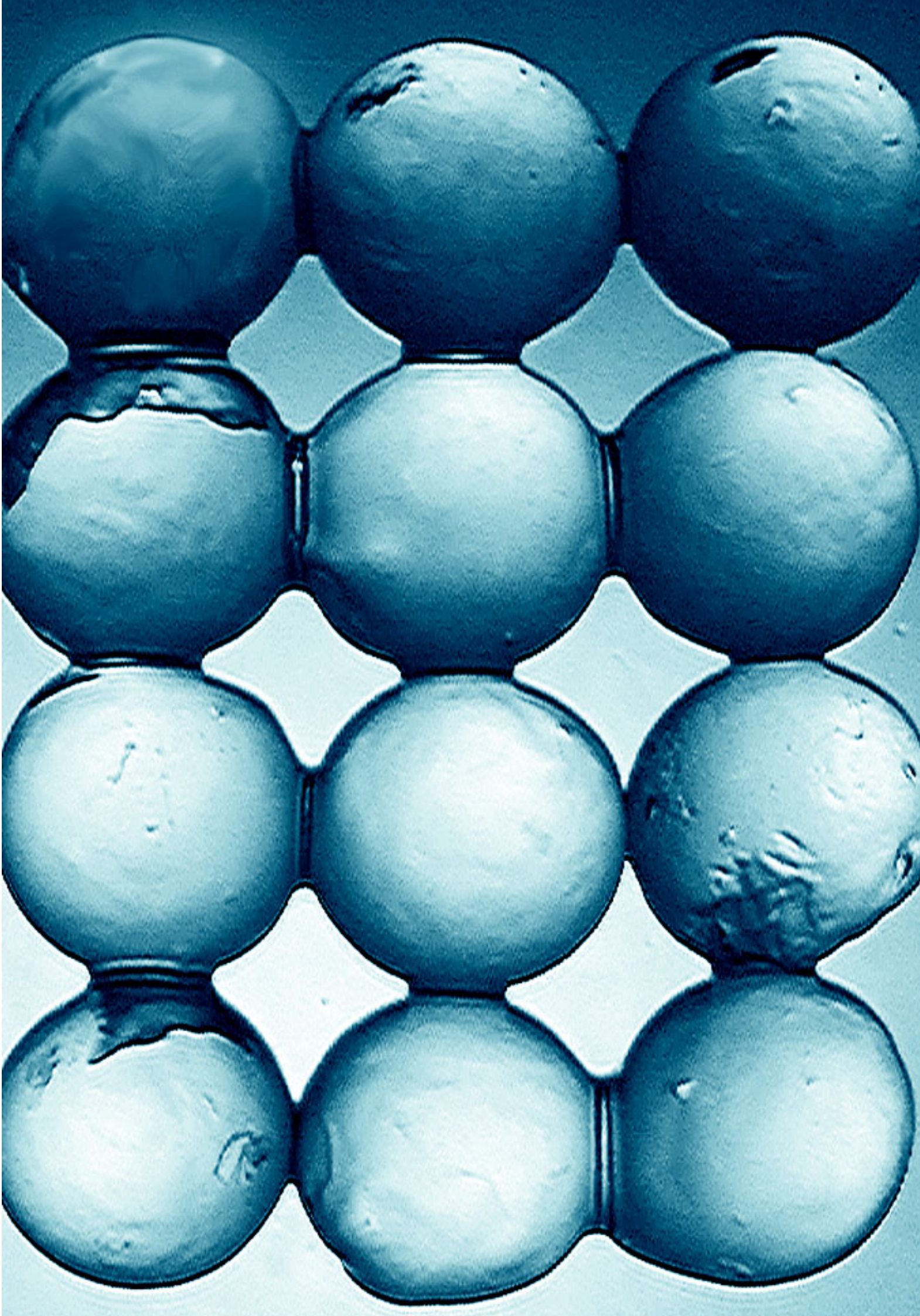


Modern environmental technology contributes to the reduced emission of ecologically hazardous substances and their minimized introduction into environmental compartments, thus providing a direct economical benefit through cost-effective and efficient use of natural resources.
The department of environmental technology does not only work on conventional processes in waste management and recycling technologies, i.e. the recovery of valuable materials and the conversion of hazardous substances and material flow optimization, but is also committed to the development of innovative methods and processes with a high value added potential. Membrane separation processes, coupled separation techniques, microstructured composite particles ("smart materials"), which stand out by high functionality in relatively small space, high quality adsorbents for novel applications, functional polymers, biotechnological mass transfer, microreaction techniques, and mathematical models for the description of complex systems and for the optimization of chemical processes are some examples of a cutting-edge environmental science which is not only added up at the end of the pipe, but integrated into the system of technological development.

Department of Environmental Technology

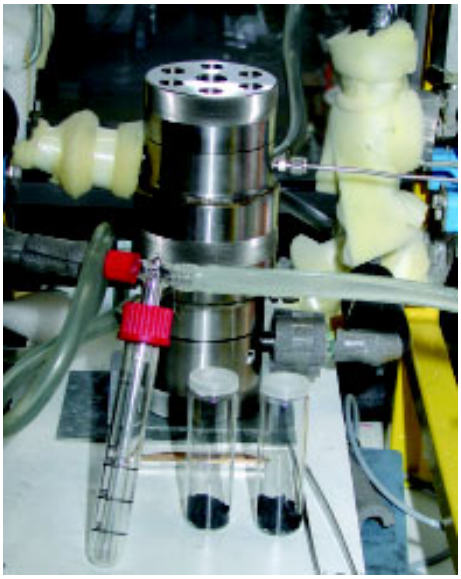
Intelligent sealing:
Gels as "intelligent sealing materials" are expandable in water and capable to automatically close leaks in wall lead-ins of hoses, tubes in public utility systems.

Supercritical Fluids

Plant used for high pressure impregnation of activated carbon using supercritical carbon dioxide

Supercritical Fluids in Process Engineering and Environmental Technology

The application of supercritical fluids (SCF) paves the way to innovative procedures for extraction, crystallization, cleaning, drying processes, and chemical reactions. Crystallization processes using SCF allow the separation of different material mixtures or the selective isolation of valuable materials. The simple phase separation permits closed solvent loops and reduces product pollution. Particle size distribution and texture of the formed solid particles can be adjusted by setting appropriate pressure and temperature conditions. To apply the innovation potential of SCF, extended basic studies and continuous progress on the process design are necessary.



Detail view of the system used for high pressure impregnation of activated carbon

The investigations are conducted either in high pressure view cell apparatus or in a 6 l-high-pressure-plant, which allows several different set-ups. For examining the results of reactions and for the characterization of the products obtained, different chemical and physical methods of analysis are available.

In order to better understand the crystallization process initiated by SCF, extensive measurements were performed on high pressure phase equilibria. Ternary model systems comprising a primary solvent, a supercritical antisolvent and dissolved solid matter were investigated. For the quantitative description of the particle formation process, population balances were applied. Solids with narrow particle size distribution, matrix particles and core-shell structures were crystallized. The impregnation of porous carbonaceous adsorbents from the SCF phase, aimed at producing functionalized activated carbon, carbon molecular sieves or retard drug formulations, yielded first product samples. As a result of specific chemical reactions in supercritical CO_2, catalytic active metal chalcogenides have been prepared.

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Working Jointly on Microreaction Systems

In microreaction technology, miniaturized micro-fluidic components (mixers, reactors, heat exchangers etc.) with sizes lower than 1 milliliter are used to perform chemical conversions. Among the technological benefits are higher process safety, increased material and heat transfer, as well as superior product selectivities. The current insufficient availability of functional microcomponents, however, interferes with this promising area of application. Throughout the world, the majority of microreactors are currently prototypes made by one-on-one manufacturing, which to date considerably minimizes the transferability to other applications.

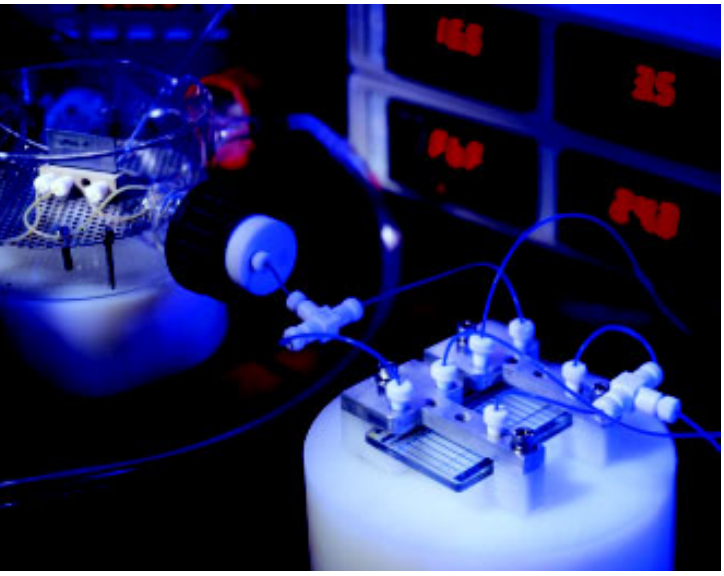
However, microreaction technology can only contribute to the advance of innovations in chemistry, pharmacy and process engineering fields, if wide application is ensured. To this objective, the dramatic gap between application potentials and requirements and lacking user proximity, availability and know-how deficiency has to be bridged. The project described here is realized in co-operation with five other Fraunhofer institutes, being financially supported by the Fraunhofer-Gesellschaft. This is a debut development of modular-structured, software-supported and universally applicable microreaction systems to be made available in sufficient number of pieces. The systems are scheduled to be applied directly sby industrial partners for investigation, testing and design of a wide range of chemical reactions.

Fraunhofer Allianz
Modulares Mikroreaktionssystem

The Fraunhofer alliance:
ICT, ILT, IKTS, IPT, IZM-M
and UMSICHT

Microreaction systems and their components are based on standardized chemical reactions. In the initial phase of project implementation, requirement criteria (specification sheets) were compiled to be included into manufacturing concepts subsequently (material, manufacturing process, dimension, etc.). Alike, a virtual microreaction component system was specified and implemented. This system will incorporate computer simulations using mathematical models as a planning and evaluation tool of microreaction operations.

Typical set-up of a microreaction process
(source: Fraunhofer ICT)



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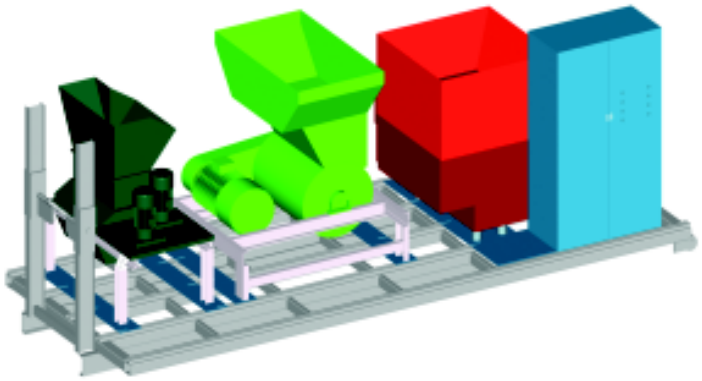
Mobile Treatment Plant

Mobile Treatment Plant for Flexible Testing of Processing and Treatment Steps – an advanced and efficient processing technology

As a consequence of the compliance with the "Technische Anleitung Siedlungsabfall (TASi)" regulations, expected to be fully in force by 2005, increased costs for waste disposal are expected for new waste material flows that have been landfilled until recently and will now be subjected to recycling or thermal treatment processes. These waste materials, besides including small amounts of single-component materials that can be readily re-used as input into production processes, in most cases include heterogeneous material mixtures containing hazardous sub-stances. Complex mechanical treatment processes such as size reduction, sorting, screening, and compaction are necessary to utilize parts of this waste. Products will have to meet strict quality requirements for loads of harmful and toxic compounds and for purity standards. Currently valid standardization procedures will be improved in the near future. Major market focus will be on the bulk-solid engineering properties of the materials: flowability, handling properties, transport volume, and transportability are significant qualities. Appropriate shaping technologies and high efficient prod-uct refinement techniques (drying, mixing, forming etc.) have to be developed to address these problems. Where waste materials have long been converted to raw materials - time has come now to start the recovery of high grade products.



Three modular load units for the transportation of specific treatment systems to the customer

Fraunhofer UMSICHT has taken up this challenge offering its new service "Mobile Konfektionierung", a mobile pilot plant enabling experts in the field to identify and to develop the most suitable mechanical process engineering steps for the treatment of specific heterogeneous waste materials. Before long, experiment-based feasibility studies, studies on recycling options, technical services and demonstration runs will be provided. The mobility of the plant guarantees instructive experimental results based on on-site operations using original materials.

The close collaboration with the Chair for Treatment and Recycling of Solid Waste Materials at the Aachen University of Technology and the Fraunhofer Institute for Material Flow and Logistics, offers a comprehensive range of services. Numerous industrial partners guarantee a high standard technical equipment.

Example of heterogeneous waste materials with high content of recoverable products and high loads of hazardous substances

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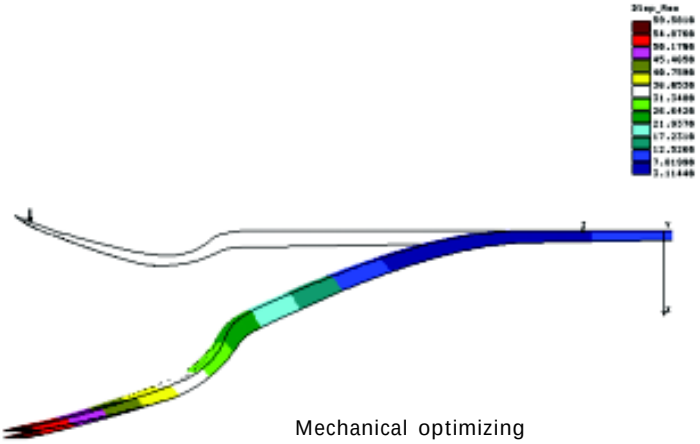
Processing of One-Way Cutlery Made from Biodegradable Materials

A recent contribution to eco-efficiency and to the preservation of fossil resources is the processing of biodegradable polymers from renewable raw materials. Products of biodegradable materials may be transferred into compost after use and, therefore, reduce possible damages to the environment.
The use of biodegradable materials is particularly beneficial for products having short life cycles. These materials include numerous products from the fastfood and catering areas, such as disposable cutlery and crockery.

The primary target of the project was the development of a disposable cutlery for the fastfood area, comprising knife, fork, spoon and coffee stirrer. The product development included material processing, design, mold development, production of samples in the injection molding pilot plant, and information management.

Disposable cutlery from biodegradable material



Mechanical optimizing of the fork by FEM structural analysis

A requirements profile and design outline were worked out based on a benchmarking study, and samples were produced by rapid prototyping process. The optimization of the individual pieces to improve their mechanical properties was carried out by finite element analysis (FEM). The material processing conducted simultaneously was aimed at obtaining high heat resistance together with fast biodegradability.
In a second step, suitable injection molds were developed. Biodegradable materials display specific rheological and thermal behavior. The feeding system, the gates, and the drafts in the mold have to be adjusted to the biodegradable material.
In the third phase, a small series of the cutlery was produced in the injection molding pilot plant to test the acceptance by the end user and to prepare the introduction to the market.

The simultaneous development of design and material resulted in attractive products with optimum performance properties. Using biodegradable materials with improved properties in disposable cutlery helped enter a new market segment for the customer, the Hubert Loick business group.

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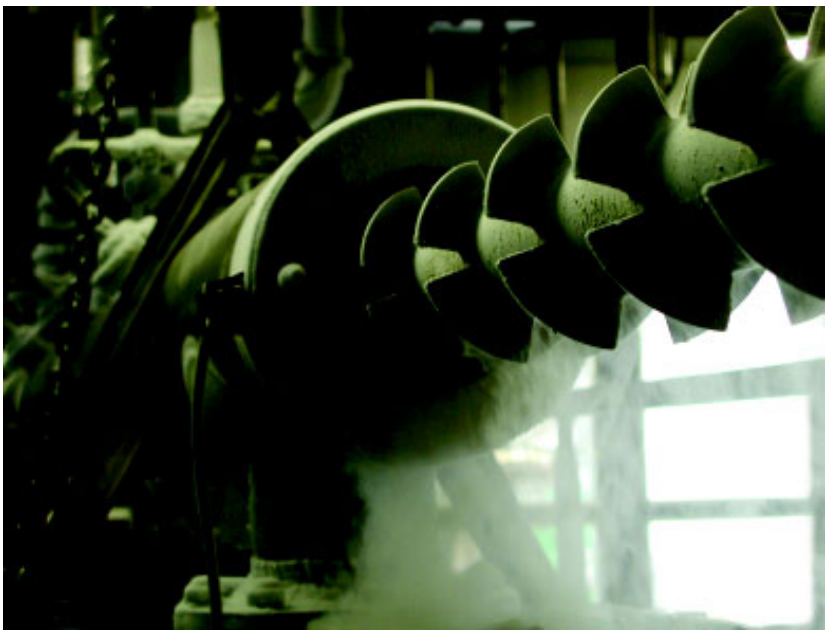
Complex Particle Architectures for Innovative Applications

Complex Particle Architectures for Innovative Applications

Mono-disperse and micronized particles, hollow micro-spheres and micro-capsules are increasingly used as functional fillers and solid additives holding significant development potentials both in materials development and in pharmaceutical, agricultural and foodstuff industries.

Particularly, the possibility of early pre-structuring of solids in the individual particles allows the precise control of powder characteristics, ranging from flowability to controled release, and paves the way to novel applications and efficient utilization of material resources.



Opened screw conveyer for material cooling with liquid nitrogen

At Fraunhofer UMSICHT, pilot and demonstration plants have been erected for the production of particles and powders with defined microstructures. Processing units of small industrial scale are available for micronization, comminution, micro-encapsulation, fluid bed granulation, spray drying, and dripping technologies.

Responding to the complex requirements in particle generation, factors like inertization and explosion-proof design have been considered in the plant installations to ensure the system suitability for the processing of organic solvents and micronized solids.

The technical implementation of particle production is supported by extensive laboratory examinations on optimized formulations and particle characterization providing systematic approaches for novel particle structures and the functional links between process parameters and structural parameters and application characteristics.

Studies in the process engineering development and application techniques are completed by mathematical modeling using both population balances and neuro-fuzzy based methods, which represent a more phenomenological-oriented approach to process simulation. Analytical modeling provides a deeper insight into the real process and gives the basis for process optimization, while neuro-fuzzy techniques are more suited for process prognosis and realization of a model-predictive controling due to their very short simulation times.

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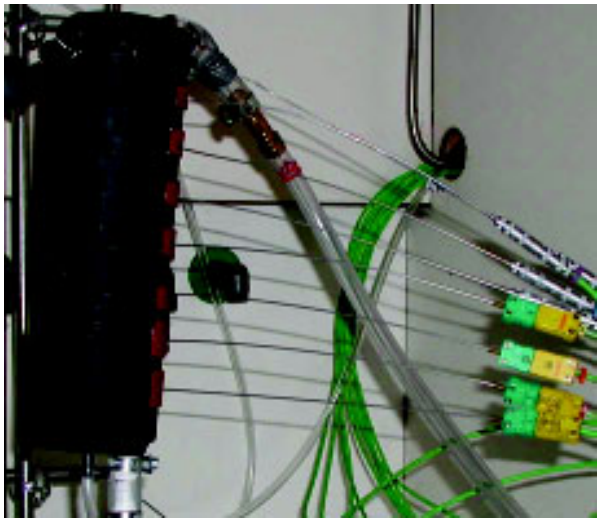
Adsorption in Automotive Carbon Canisters

Activated carbon canisters for the adsorption of hydrocarbon emissions from automotive systems have to be improved continuously. Major requirements are low weight, small size, optimum operation of emission control, and excellent integration into the complete system. Activated carbons adsorb the highly volatile compounds (VOCs) of the fuel, which leave the tank while the vehicle is running or standing. In the U.S., the devices are also used to adsorb fuel vapors occuring at the refilling of the tank.

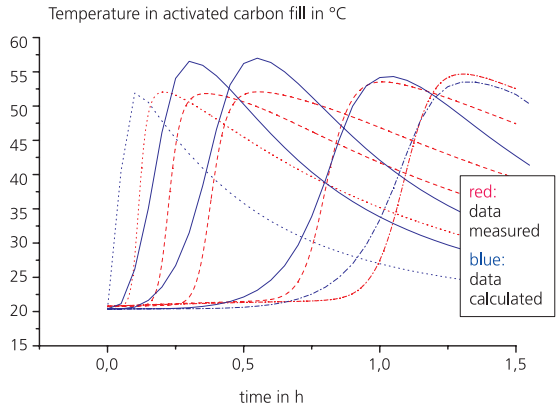
The emission control systems need to undergo several tests to be admitted for practical applications. Prior to the emission tests, the canisters are loaded with a butane/nitrogen mixture and purged with air. The study is aimed at simulating these adsorption and desorption processes.

A one-dimensional, non-isothermal model is applied to predict the break-through curves, the weight gain of the carbon fill, and the temperature profiles. The model is based on mass and energy balances. No inter-particular gradients are assumed to be of inter-particular significance. Global coefficients and driving forces describe the interactions between the bulk phase and the solid phase.



Automobile activated carbon canister with temperature measuring points

Figure 1: Comparison of experimental and predicted temperature profiles for the adsorption



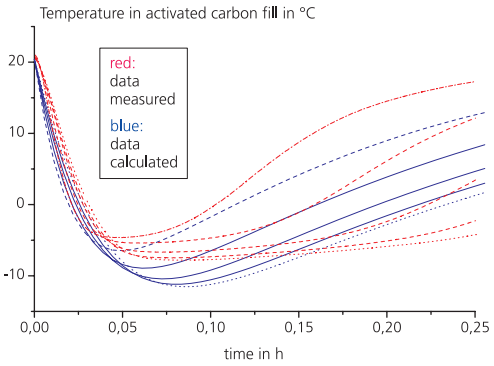


Figure 2: Comparison of experimental and predicted temperature profiles for the desorption

Validation experiments are carried out with a test rack (ACON/NT, Mahrenholtz+Partner, Hanover), which is used for the pre-conditioning of automotive carbon canisters. The activated carbon bed (diameter 8.5 cm, length 21 cm) is equipped with five thermocouples arranged at different heights of the carbon bed.
Several simulation runs have been performed to verify the model. Fig. 1 shows the calculated and the experimental temperatures in the adsorption bed. Starting at ambient temperature conditions, the temperature reaches peaks up to 58 °C. The moving adsorption front can be taken from the figure.
Fig. 2 shows experimental and predicted data for a desorption run. Starting at ambient temperature, the temperature initially drops down to less than -5 °C. Then the canister slowly reaches ambient temperature due to the thermal energy of the gas inlet stream.

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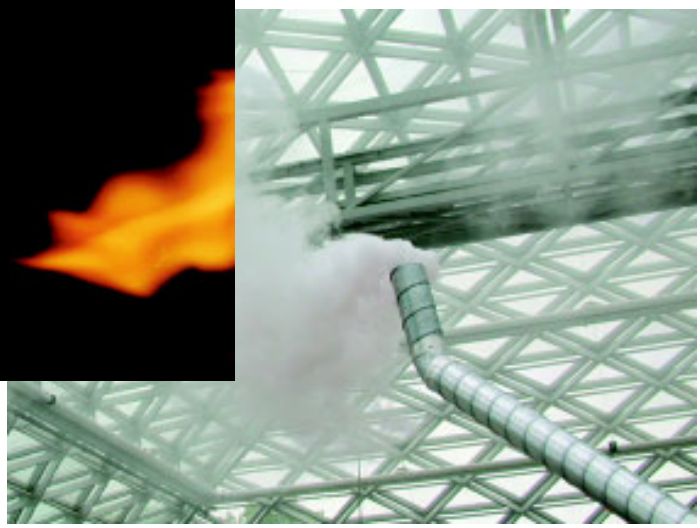

All for fire prevention: Process for the practical testing of smoke extraction in buildings

Department of Safety and Process Technology

The safe and optimum operation of industrial plants and processes and the reliable control of technical processes are fundamental for modern enterprises. Efficient operation as well as compliance with safety requirements for staff, for the neighboring area, and the environment has to be ensured.

The department of safety and process technology specializes in process engineering design, in the optimization of operation processes, and in safety assessment of industrial equipment and processes. The prime objective is to support our customers in the development and operation of economical processes which at the same time meet the corrently valid environmental and safety requirements.

Services in the areas of plant safety, fire and explosion prevention, process analytics, information and pipeline technologies are offered. The development of environmentally friendly software systems to be applied in safety and process engineering for the process simulation serve as technical and legal information systems representing an intelligent tool combining the varying fields of expertise.

Dangerous Operational Situations in Pipeline Networks

Recognizing and Redusing Dangerous Operational Situations in Pipeline Networks

Dangerous operating conditions in pipeline grids may be caused by transient stream processes resulting in multiple increased pressure system and the related load. This may lead to considerable risks to mankind and technical environment.
Depending on the specific industry, different operational circumstances may lead to so-called pressure surges, cavitation and condensation hammer, as listed below:

- contact condensation of steam and water (power stations)
- sudden change of the liquid velocity (water, chemical industry)
- plug flow (oil and gas)

Dynamic flow and stress calculations for pipeline systems must therefore be included in the planning of process engineering plants to stay abreast of operational safety aspects.

To consider transient processes at the lowest possible time consumption in the planning phase, the current software environment FastFSI (Fluid Structure Interaction) will be developed in a three-year R&D project. This project is based upon suitable coupling and considerable acceleration of the existing software systems (CAD-Software, fluid statics/dynamics and structure statics/dynamics). A cooperation project involving Fraunhofer UMSICHT, Fraunhofer SCAI, and industry partners has been established to look into these problems. Calculations of the hazard and risk potentials of a pipeline section indicating dynamic flow processes have been performed.

To optimize the software program, various test series with different practice related scenarios have been conducted. The experimental results are used for the software validation.

Additionally to the experiments, pressure surges calculations using the commercially available software program MONA are currently carried out. In the framework of the European network project “WAHALoads”, thermal hydraulic and nuclear techniques scenarios are conducted at the test rigs of the Institute. The validation procedure helps identify deficiencies of the newly developed software environment and improve the commercial simulation program MONA.
For the construction of a processing plant using the suitable, new and improved simulation programs MONA or FastFSI, the fluid dynamic and structure dynamic process in pipelines have been incorporated in a more appropriate and efficient way.

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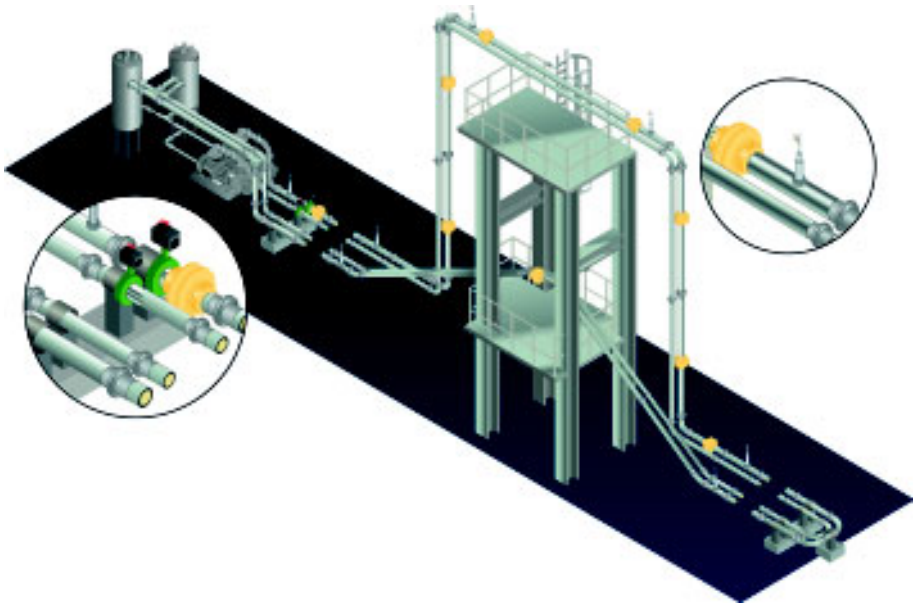
Pipeline test rig at Fraunhofer UMSICHT



Hot smoke tests with pool fires

Smoke management in buildings with a complex geometry requires an adequate prediction of the behavior of smoke in real fire situations. The demand for practical compliance tests after completion of the building has therefore increased over the recent years. Fraunhofer UMSICHT has developed a practical testing procedure for buildings already in use, which is based on blower-type gas burners as test-smoke heat sources and aerosol addition for the visualization of the buoyant gas flow, combined with temperature and gas concentration measurements in the building under test.
In large-volume spaces, e.g. in high atrium buildings (> 10 m height), the heat output of the gas burners (max. 150 kW each) is not sufficient for a realistic and reliable simulation of the buoyant plume attributed to the design fire, which has a typical heat release rate in the MW range.

Practical smoke test in an atrium building: heat and smoke source

According to the regulations of some local building authorities, both the height and time dependency of the smoke volume flow rate have to meet the design fire conditions in the practical test. Safety considerations, however, usually do not permit smoke tests with the design fire heat release rate.

In order to extend the application range of the smoke-test procedure, the use of pool fires as heat sources burning ethanol in steel trays of varying size has been investigated. Consistent with an Australian standard, the fire trays were placed in a water bath which ensured a constant and well-defined heat release rate during the test. Heat release rates up to 1.5 MW have been achieved this way.

A test set-up using an array of pool fires has been developed that permits a realistic, time-dependant smoke production at volume flow rates typical of design fires with much higher heat release rates. In combination with the know-how and the devices for a precise documentation of the smoke spread in the building (temperature and CO_2-concentration measurement) developed by Fraunhofer UMSICHT, a direct evaluation of the performance of the smoke management system has become possible under conditions very close to the design fire scenario.

Practical smoke test in an atrium building: smoke layer below the ceiling

The use of pool fires as heat sources has proven to be a reasonable and safe option. In large buildings of different type (high atrium buildings, industrial halls, exhibition and representative buildings), hot smoke tests have been carried out successfully this way. Observing a number of safety precautions, this procedure offers an affordable opportunity of realistic and validated smoke management system tests in buildings which are already in use or close to commissioning.

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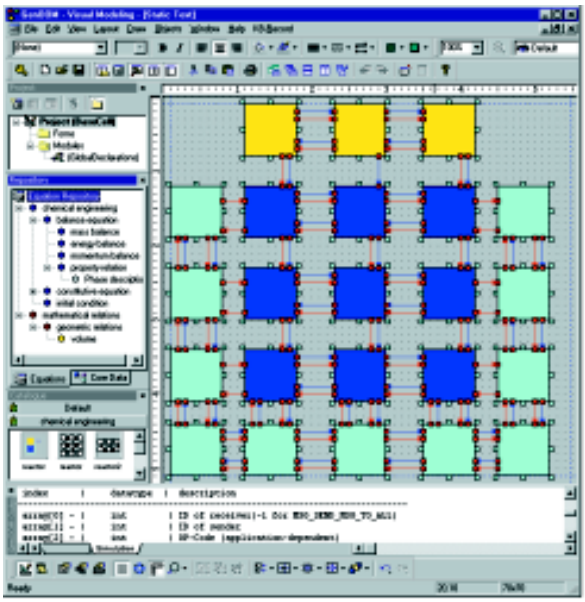
SimCARE – A Software Tool for Development and Implementation of Flexible Simulation Models in Sustainable Process Technology

The technical implementation of chemical reactions requires intensive contact among the participating phases. Operation conditions differ individually. As no process is exactly like the other, standard reactors are not established in industrial practice, but most specialized chemical reactors are widely used. Chemical reaction modeling must consider this circumstance. Hence, modular simulation tools are necessary, which are working time-efficient and flexible on different modeling scales (e.g. scale of molecules, phases or equipment).

The new SimCARE tool is specifically designed for future industrial applications. This boundary condition requires both the detailed modeling of relevant chemical and physical processes, and simulation runs with short run times. As a convincing modeling strategy the "multiple dimension cell net model" is applied. The cell net model represents the main flow characteristics of a chemical reactor (e.g. circulation flow pattern) and overlaid secondary flows (e.g. back flow or turbulent flow).

Chemical reaction modeling should be flexible, transparent, and re-usable. The setting up of SimCARE models is supported by the generic object-orientated modeling tool "GenOOM". The graphical user interface of this tool enables the user to easily draw up a characteristic cell net model of the chemical reactor or his reaction system needed.
The executable simulation code is automatically generated by GenOOM.



Screenshot of graphical user interface and exemplary cell net model

Effective numerical strategies are necessary to solve the generated mathematical model equation systems. In co-operation with Fraunhofer SCAI, time-efficient numerical algorithms, such as waveform relaxation algorithms, are developed and tested.

The entire software architecture of the SimCARE tool is based on the concept of distributed applications, drawn up on Microsoft´s DCOM standard, i.e. SimCARE is applicable in intranet or internet.

SimCARE offers the user comfortable features to quantify relevant physical interactions within the cell net model including ergonomic interfaces to specify general model qualities. Efficient methods for graphical post-processing of simulation results are available.

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Flooding precautions in Hilden on the Rhine

©G. Kries
Whitsunday of 2000, at Kindsbach, district of Kaiserslautern

Joint Study Disaster and Emergency Management Systems

It is not only since the tragic events on 11 September 2001 that improved IT support for disaster and emergency management is a primary requirement across Germany. Taking appropriate precaution measures to minimize the effects of similar disastrous events is mandatory. Mitigation planning reduces the impact of these catastrophes for human life, the environment, and is cost saving. In the case of a disaster, adequate information technology and decision support systems to help accurately assess damages, select appropriate recovery measures, and organize rapid, target-oriented aid.

This has been the motivation for the Fraunhofer-Gesellschaft, a world-wide operating contract R&D organization, to charge a selected group of Fraunhofer-Institutes with the task to assess challenges and potential technological solutions in the field of emergency and catastrophe management. A market analysis for the potential marketing of already available and new information and communication technology (IT) was conducted. The survey addresses selected experts and decision-makers in order to better understand the demands and requirements of companies and institutions dedicated to disaster and emergency management, as well as to gather experiences and identify potentials for future research and development.

A workshop held in December 2001, focused both on the application types in the disaster and emergency management areas from the point of information technology (IT), and on the assessment of IT requirements based on practical scenarios. Finally the information compiled is evaluated with regard to market segments, the R&D requirements are identified and the market segments are elaborated. Consequently, product concepts are to be developed, which will be systematically refined in follow-up projects with key customers, in order to be scaled up to pilot systems.

IT-supported disaster and emergency management

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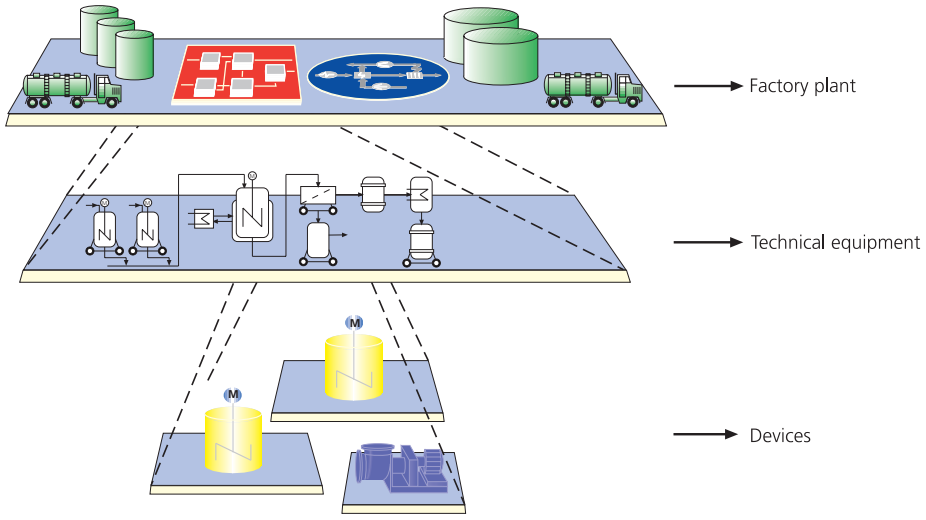
Integration of Logistics and Process Engineering



Levels of process structuring

Simulation System for Integration of Logistic and Engineering Processes (SILVER)

In process industries, a trend towards developing and producing innovative, high-price products in small and middle batches is clearly distinct. Many of these products were usually produced discontinuously in multi-purpose-plants leading to strongly networked processes. Specific planning and optimization of multistage batch processes involves complex material and temporal linking between different process units and production logistics. This is where simulation-supported methods have to be applied.

Based on a model "multi-purpose" plant, presenting a plant with the fundamental standard process equipment and logistic transport means, the connected view through integrated simulation systems seems to be a promising approach. The coupling is designed to be performed via a suitable platform to build an online interaction between discrete and continuous simulation as well as decision support tools. In laddition, communication and cooperation within the involved planning teams has to be enhanced. Therfore, an existing, qualified group ware component can be used to consider of the according modifications.

The homogenization of the data pool for the integration of process and logistic problems will be advanced in the scope of developing an integrated platform. Beside an overlapping view, progress regarding a common time-efficient and sustainable modeling strategy will be achieved. Through a simultaneous view of logistic and process aspects by integrated simulation systems, techni-cal and economic potentials as a result from the optimum integration of all process components may be elaborated. This will lead to a better exploitation of technical equipment and human re-sources and a higher product quality.

SILVER is a joint research project of Fraunhofer Institutes and former GMD Institutes which have recently been included into the Fraunhofer-Gesellschaft, and is funded by the Federal Ministry of Education and Research (BMBF).

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Safety Engineering Measures for the Storage of Hazardous Substances

Interactive Determination of Safety-Relevant Requirements and Measures for the Storage of Hazardous Substances and Wastes

The storage of hazardous substances and wastes is usually inevitable for producing and processing enterprises. Legal regulations are often vaguely known, details remain imprecise – the feeling of uncertainty prevails. The knowledge of the relevant regulations and their technical and organizational implementation is mandatory in order to avoid dangers and untenable risks.
However, the search for the necessary measures in the extensive set of rules becomes very time and labor consuming. With the knowledge-based information system LAGERguide, the determination process is substantially facilitated and accelerated.

Typical storage of hazardous substances and waste materials

The developed system is structured in a modular way and encourages the solution to different questions. The dynamic sequence of interactive decision flow charts, built on questions, selections and input elements with references to comments, result and regulations, guides the user by a determination process from four work procedures:

1. Consideration of the field of application:
   Check for specific substances, institutions, activities etc.
2. Substance classification:
   Classifying of substances according to danger characteristics and physical state into 10 substance classes, complying with the concept for the common storage of chemicals issued by the German Association of Chemical Industry (Verband der chemischen Industrie, VCI).
3. Data capturing:
   Entry of stock location, stock containment, amount of materials, storing conditions, etc.
4. Knowledge transfer:
   Imparting of the problem-relevant safety requirements and precaution measures.

The technical contents consider the ruling law on pollution control, water protection and waste disposal as well as on equipment safety and protection from hazardous substances.

The current result status may be seen during the determination process at run time.
The yields are documented in a specification sheet indicating stock type and stored substances including legal requirements for permission and the relevant measures concerning material selection, sizing, equipment, distinguishing marks, implementation, safety distance, safety checks, common storage or operational procedure guidelines, each with a legal source proof to the set of rules.
LAGER*guide* may be accessed via internet on www.verfahrenstechnik-online.de.

Graphically supported control of the determination process in the LAGER*guide* program

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Department of Energy Technology

The department of energy technology deals with the development, monitoring, analysis, and the management of economical and sustainable energy supply and distribution plants.

Process engineering calculations and simulations as well as operational and structural optimization of complete energy supply systems, for single units or components are performed, and pilot and demonstration plants are built.
The current focus is on the testing, market introduction and application of innovative systems of combined heat-power-cold generation (CHPC) and the efficient use of biomass, coal mine gas from abandoned mines (CMM), biogas and other lean gases. Additionally to traditional district heating co-generation power stations, the combined generation of heat, power, and cold, such as thermal cold generation, fuel cells and microturbines has increasingly come into use. The traditional distribution of central and district heating is well covered. The power supply of solar thermal and geothermal recovery are among the prime objectives of current project work.

The service range is completed by energy supply concepts, technological and economical assessment studies of plants and projects, as well as market analyses and feasibility studies.

Methane gas – in the air a highly flammable and explosive mixture controlled extraction is of double use. Well-regulated energetic utilization of coal mine gas minimizes the risk and hazards by discharged methane gases.

"PEM-Oberhausen":
Module Power Station with Fuel Cell

"PEM-Oberhausen" – A New System of Energy Supply

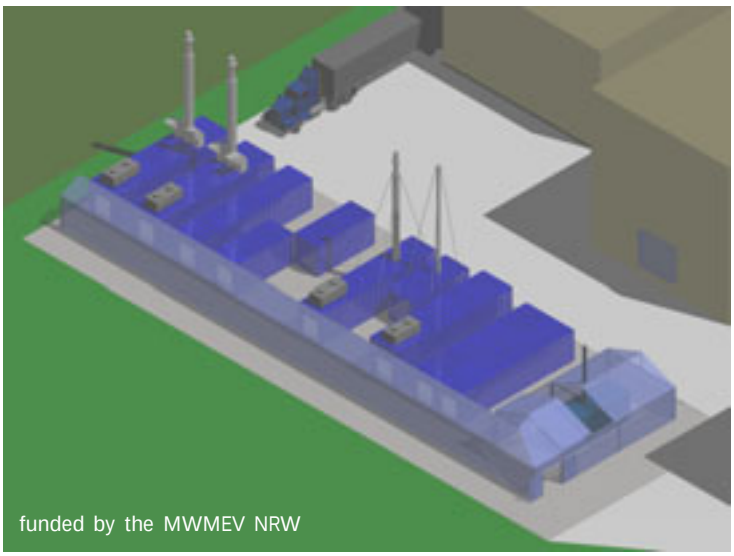
Covering the ever growing demand of energy, saving energy resources and preserving the environment - fuel cell technology is one of the most advanced technologies capable of meeting this challenge. Fraunhofer UMSICHT is committed to this new development and has installed a fuel cell run module power station providing an efficient on-site supply of electricity, heat and cold. This energy supply system comprises the most modern aggregates currently applied for decentralized energy generation:

- PEFC fuel cell CHP (250 kW_{el})
- microturbine (100 kW_{el})
- gas engine CHP (450 kW_{el})

The energy supply unit is completed by an absorption chiller which contributes to the air conditioning of the institute buildings. The system will be commissioned in May of 2002.

Besides natural gas, coal mine methane will be employed in the module power station which, after the drilling work, will be extracted from a disused coal mine at the premises of the institute.

According to today's fuel cell technology standards, regenerative fuels can be used only after the processing of gas. Fraunhofer UMSICHT has therefore looked into and assessed various methods of gas processing. Additional thermodynamic calculations have been made to identify the quality of gas suitable for the use of renewable fuels such as biogas or wood gas. The gas processing of high temperature fuel cells and particularly the Molten Carbonate Fuel Cell (MCFC) has proven to be less consuming and offers high efficiency.



"PEM-Oberhausen" module power station: General view of the energy supply system including fuel cell, microturbine, conventional gas engine, and absorption chiller

Beginning from mid-2002, Fraunhofer UMSICHT will take on the operation of an MCFC pilot plant with gas qualities from real gas sources (e.g. sewage plants), continuing the development and optimization of gas cleaning technologies.

Pressure swing adsorption plant

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Leak Locating Using the Helium Tracer Gas Method

Successful Leak Locating using the Helium Tracer Gas Method

Leakage in pipeline systems such as district heating systems, drinking or chilled water systems and steam pipe networks causes high costs due to leakage losses and continuous corrosion damages. Until recently, the precise leak detection at buried pipes in many cases has not been possible.

Fraunhofer UMSICHT has developed a new tracer gas method, which allows leak locating to be performed without interruption of the normal supply operation. The non-poisonous, incombustible and non–corrosive noble gas helium is added to the media (e.g. in the district water heating system) using a small process unit. In the case of a leakage, it desorbs from the fluid and migrates to the surface by diffusion. The leak may then be precisely located by helium detectors.

First prooftesting of the method in the on-site pipeline test field facilities as well as field testing at the premises of a local energy provider, the Energieversorgung Oberhausen AG (EVO), yielded very convincing results: A number of leaks were found in various municipal district heating systems during service checks of ventilation openings for damaged pipe sections. The helium leak search helps reduce operation costs and is provided to public utility net operators as potentially expandable system service.

Extensive and methodical field prooftesting will be performed under varying local conditions to verify and refine the method in all types of district heating pipeline systems. Part of the program will be government-funded. Public utility providers are invited to offer on-site facilities for leak detection testing and support the project as co-financing project partners.

Leak in district heating pipe successfully detected using dissolved helium

Mobile service unit to dissolve helium in water

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Innovative Cold Supply and Networks

Chilled Water Generation with Solar Heat or Waste Heat Extraction from Fuel Cells

In summer season, waste heat sources and the high solar radiation often remain unused due to low heat demand. Thermally driven chiller processes allow the generation of cold from available heat. The waste heat of combined heat and power plants (CHP) such as hydrogen fuel cells, could also be used more efficiently. Therefore, Fraunhofer UMSICHT has taken on to set up a system for chilled water supply based on solar heat or waste heat from hydrogen fuel cells.

Vacuum tube collector field

This application requires the installation of a large vacuum tube collector field of 75 m² (absorber surface area). The plant generates heat for the heating systems in winter, in summer the heat is recovered for the operation of an absorption chiller to generate chilled water to supply the HVAC-systems. The expertise gained in this area will facilitate the further development of solar heat/waste heat driven chilled water generation and contribute to the further optimization of combined heat, power and gold Generation plants (CHPC).

View of the banking district of Singapore

District Cooling Networks, Cold Supply Systems for Process Cooling and Land Properties

In 2001, Fraunhofer UMSICHT provided consulting to a large university hospital in the reengineering of their chilled water networks. Systems for gas cooling and/or gas scrubbing by adsorption were delivered to numerous customers after removal of siloxane components from digester gas. Additional thermally driven refrigerating processes based on steam jet refrigeration were installed. For ice slurries, a closed rheological model was derived based on the Casson model. Air conditioning equipment for laboratories using CryoSol® as ice slurry is a future project.

The construction of a large district cooling network was evaluated for the equator-near city of Singapore. In the district of Jurong Town, a chilled water demand of about 300 MW is expected for the next 15 years. An environmentally sound, centrally driven chilled water generation from waste heat from industrial sources is possible. Power savings of about 200 000 MWh/a electricity may be achieved as a result.

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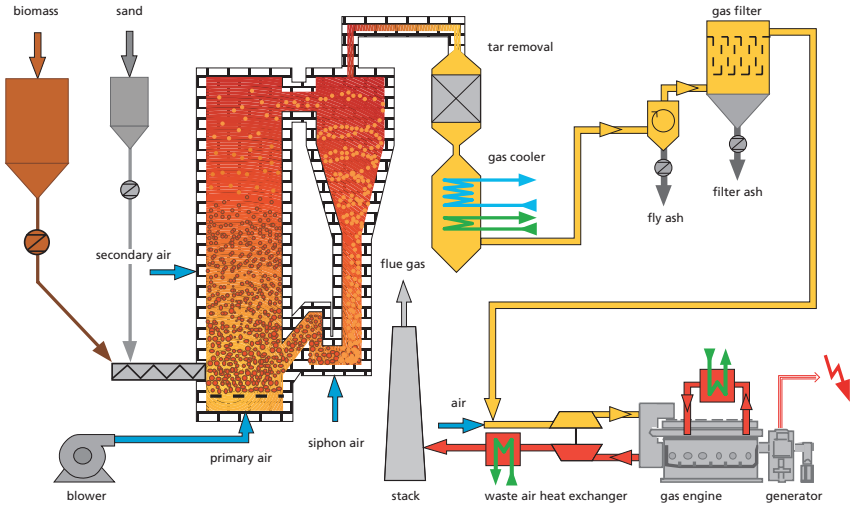
Optimized Energy Generation from Biomass

Fraunhofer UMSICHT has been committed to the areas of wood gasification and power generation in IC gas engines for numerous years. Continuous operation tests have been carried out successfully in the in-house pilot plant, and detailed scientific examinations on conversion rates and kinetics in gas phase reactions and catalysts have been performed. The efficiency of a catalytic tar cracker – the key component of the system – has been significantly improved by developing new flow concepts, cleaning and reactivation strategies of the catalyst. Power plants based on this concept of biomass gasification stand out by a number of benefits, compared to conventional combustion plants using steam turbines. This is mainly a result of the power range of less than 5 MW_{el}, yielding gross electric efficiencies of up to 30 per cent that can be realized with these power plants.

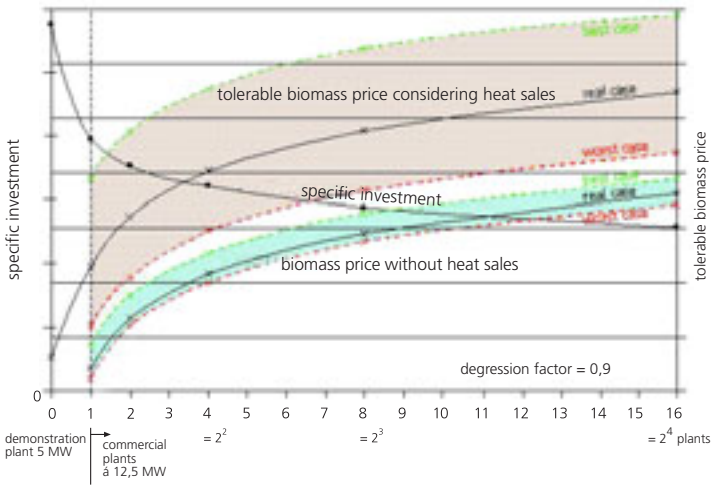
Licensed operation of a wood gasification site – to date without district heating co-generation plant – is expected for the first quarter of 2002.

Negotiations with three site-operators on the erection of commercial scale demonstration plants are currently in their final phase. The envisioned plant is scheduled for a fuel input capacity of 5 MW or 1.45 MW_{el}.

Scenario analyses performed for commercially run power plants of about 12.5 MW, based on reasonably priced fuels, have yielded that reduced specific investment and operation costs, optimized dimensioning, enhanced automation, higher availability, and increasing electric efficiency hold great promise for attractive economical benefits for plants of this type. As soon as five or six plants of the 12.5 MW type have been set up, fuel prices below 40 •/tons may be achieved, allowing also for the economical use of uncontaminated biomass fractions.



Process scheme of a circulating fluidized bed gasification plant (CFB) for heat and power generation in an IC-engine combined heat and power plant (CHP)



Present economic situation and predicted cost development based on the number of realized gasification plants (example of wood gasification)

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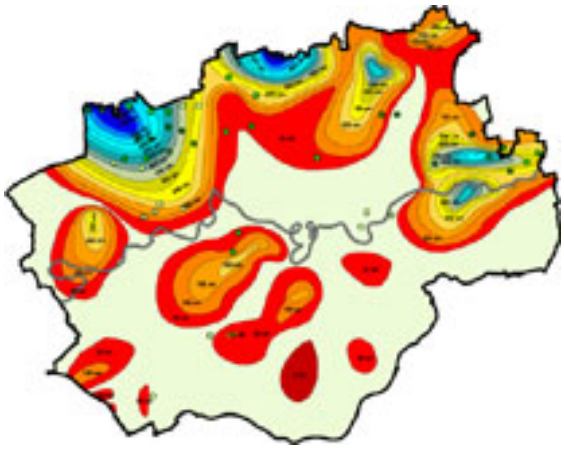
Coal Mine Gas – Energy Regeneration and Hazard Prevention

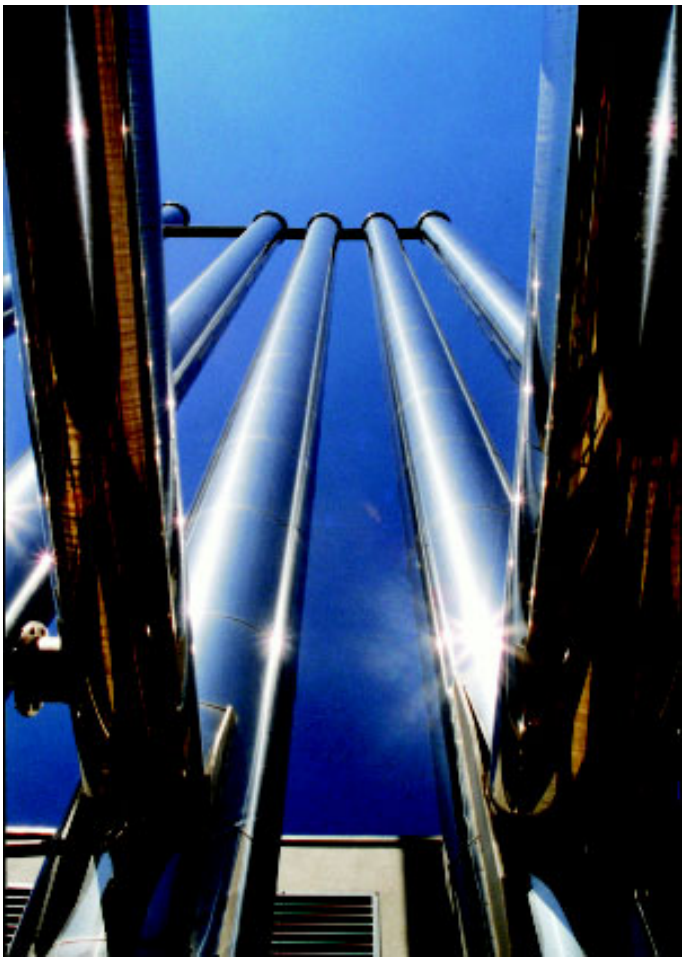
Coal Mine Gas – Energy Regeneration and Hazard Prevention

Coal mine gas (CMM) is a methane gas that is emitted at derelict coal mines and is by many times more detrimental to the climate than carbon dioxide. Fraunhofer UMSICHT has been committed to the energetic recovery of coal mine gas for many years. In 2001, a number of CMM powered co-generation plants were commissioned, and the widely recognized UMSICHT Methane Gas Conference had its second meeting at Oberhausen.
A special work group on methane gas was established by the agency "Landesinitiative Zukunftsenergien Nordrhein-Westfalen", a regional organization to advance future energies in North Rhine-Westphalia.

Coal mine gas in the air proves to be a highly flammable and explosive mixture that is accumulated in cavities and may become hazardous. The well-regulated energetic recovery of methane gas is therefore essential also for reasons of active risk prevention. Risks and hazards in residential areas due to the emission of methane gas may be minimized.

Geographic information system GIS offers a fast overview of methane gas findings





Coal mine district heating co-generation plants:
In vogue, cost-effective, and environmentally sound

Fraunhofer UMSICHT has undertaken to digitize all relevant data on the example of the city of Bochum resulting in a Geographical Information System (GIS). Using this comprehensive information tool, legislators in district and municipal boards are better informed on the risks caused by methane gas. This may be a first step of an up-to-date cadaster in a future regional environmental management system.

Additional environmental parameters (heat consumption density, regenerative energy potentials, soil protection, waste management) are scheduled to be included into this future cadaster. The user may visualize and geographically classify all relevant findings. The geographical overview allows easy capturing, administration, analysis, and presentation of data.

Contact

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Energy Analyses, Energy Concepts, Project Assessments

Energy Analyses, Energy Concepts

The major focus in 2001 was on developing energy supply concepts for the waste heat recovery from waste water extracted from lignite mining sites, assessment studies of the combination of two district heating networks, and for a large entertainment and leisure park.

Energy analyses for a variety of customers with individually structured contracts were performed additionally.

The energy demand of a soccer stadium is characterized by peak energy consumption during the games.
The electricity demand of the BayArena (stadium of Bayer Leverkusen, a team of the National Soccer League) was analyzed to assess and optimize consumption.

View of the BayArena, calm before the storm
Source: Kadlec/Bayer 04

According to the results, 90 per cent of the total energy demand were consumed during days without matches or tournaments. Floodlighting, display monitors and media sections such as press boxes are the main consumption sources, causing one third of the energy costs (higher energy cost for peak consumption times).

Optimized operation of the floodlighting equipment through load control systems during matches will lead to cost savings of 20,500 • p.a. Peak consumption predictable from the schedule of events allow the low-cost acquisition of electricity at regional energy trading markets.

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Techno-economic assessment studies of biomass power plants

As a consequence of the introduction of the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG) including the provision on the energetic use of biomass (BiomasseV), power generation from biomass has been met with roaring success throughout Germany. Fraunhofer UMSICHT has been dedicated to the assessment of a variety of project concepts of biomass run power plants on behalf of banks and leasing-companies. Detailed assessments of risk of construction, risk of operation and full operation costs were included. Since the economic success of the plants is significantly dependent on fuel availability and pricing, both the risk of feed stock availability, and the local biomass market were evaluated for present and future requirements. Consideration was also given to power plants rivaling for limited amounts from demolition wood as well as to future amendments in German waste related legislation (TA Siedlungsabfall) which are expected to relieve today's fuel shortages.

Biomass power plants are experiencing a boom. The figure shows a medium sized plant in the lumber industry.

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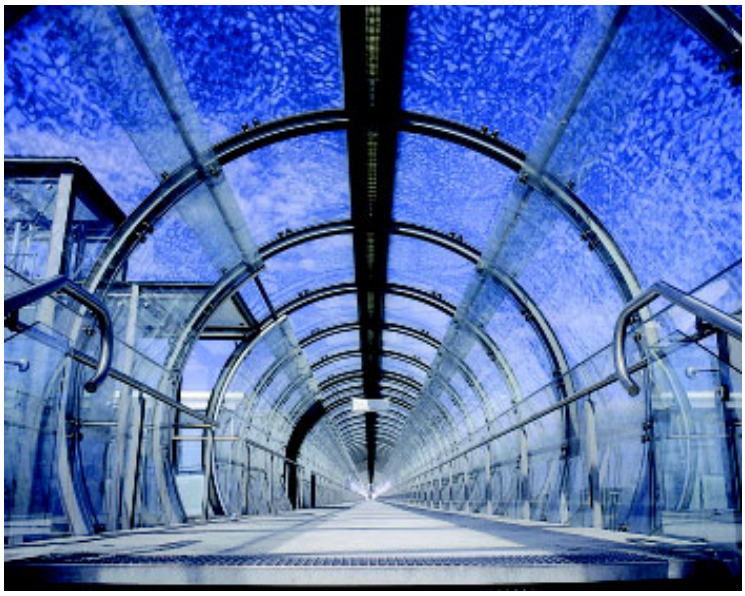
The department of knowledge and technology transfer is dedicated to bringing the broad range of innovations elaborated at the Institute to the market.

The distribution to the market is performed through the transfer of know-how (vocational training), through technology transfer across the national border (international project development) and through application of our know-how and experience in spin-off enterprises. On request, direct consulting services are offered to customers in the areas of R&D projecting and the implementation of innovative techniques.

Department of Knowledge and Technology Transfer



On the path to transnational and interdisciplinary knowledge transfer

International Project Development

Globalization and the growing international competition represent the challenge of today's economic and cultural activities, a challenge that also addresses the scientific world. Establishing the department of "International Project Development" at Fraunhofer UMSICHT in 1997 has been one measure to respond to this challenge.

The department focuses on internal and external services in the fields of scientific and economical co-operation responding to the requirements of the scheduled enlargement of the European Union. The German-Polish Research Network INCREASE and the North Rhine-Westphalian Initiative for Foreign Economy are networking platforms to ministries, scientific and economic organizations providing assistance to internal and external customers.

Over the past few years, activities at Fraunhofer UMSICHT have been focusing on regions in Central and Eastern Europe, whereas now these activities are being expanded to other countries.

3rd INCREASE-seminar in Warsaw, June 2001 (left to right: Prof. Górak, Prof. Buzek, Doc. Buzek, MR Schlicht)

INCREASE

"Addressing current environmental problems and contributing to the improvement of German-Polish relations through co-operation in collaboration projects". This is the guideline of INCREASE (**In**ternational **C**ooperation on **R**esearch in **E**nvironmenta**l** Protection, Process **S**afety and **E**nergy Technology), established at Warsaw in 1997. Today, over 30 scientific institutions of both countries are incorporated in the INCREASE network.

A variety of projects in co-operation or on behalf of the industrial partners from both countries have been carried out by the INCREASE members. The topics are mainly related to the environmental protection and energy technologies sector. Two head offices – under the directon of the chairmen of the Steering Committee, Prof. Dr.-Ing. Andrzej Górak (University of Dortmund), and Prof. Dr.-Ing. Stanislaw Ledakowicz (TU Lódz) – are coordinating the INCREASE activities.

Fraunhofer UMSICHT is involved in a variety of German-Polish collaboration projects and is the German Head Office of INCREASE. The Polish Head Office is based at the Polish Academy of Sciences in Gliwice.

North Rhine-Westphalian Action Program for the Promotion of External Trade with the Central and Eastern European Countries (CEEC)

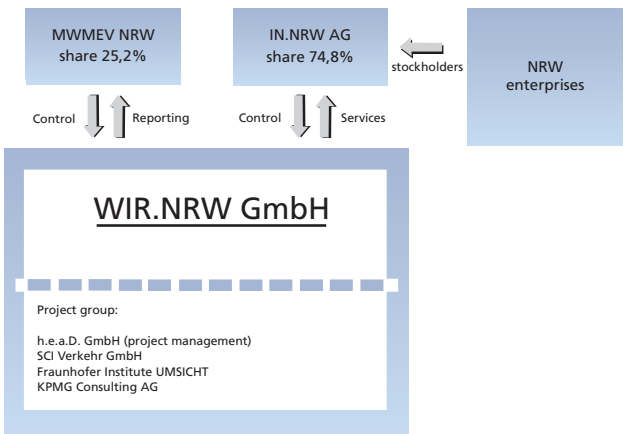
After multiple years of preparation, the North Rhine-Westphalian Action Program started work successfully in January 2001. North Rhine-Westphalian enterprises involved in the fields of environment, transport and energy sectors are operating closely with the Ministry of Economic Affairs, Energy and Transport (MWMEV) in a unique public-private-partner-ship (ppp) structure. The overall aim is to identify synergetic opportunities and to advance the launch of joint enterprises with partner companies based in Central and Eastern European Countries.

In the four target countries – Poland, Hungary, Czech Republic and Romania – early information on projects, which has been elaborated in special workshops expert meetings, and political assistance is provided to the ppp partner members. The information is related to project opportunities for design and construction enterprises as well as for operators in the environment, energy and transport sectors.

Stockholders' meeting of the IN.NRW AG on July 3, 2001 Carl Duisberg Centers gem. GmbH, Fichtner GmbH & Co. KG

The core of the ppp-structure is the WIR.NRW GmbH which dates back to late 2000. The MWMEV and the IN.NRW AG are partners of the WIR.NRW GmbH. The IN.NRW AG represents the private part of the ppp-structure. Interested North Rhine-Westphalian enterprises are invited to buy shares and thus profit from the program.

The North Rhine-Westphalian Action Program CEEC is realized in public private partnerships



On behalf of the WIR.NRW GmbH, a project group made up of four enterprises supports the stockholders. Fraunhofer UMSICHT acts as adviser in the field of environment and energy topics. Other members of the project group are:

- SCI Verkehr GmbH consulting partner in the transport sector
- h.e.a.D. GmbH who is responsible for political topics, and
- KPMG AG, consulting services in the fields of program related financial and organizational issues.

Contact

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Dipl.-Biol. Volker Knappertsbusch
(02 08/85 98 -12 32)

Learning on the job Theoprax®

TheoPrax® presents a practice- and system-oriented education model aimed at linking theory and practice in learning. The program dates back to 1998 when it was introduced by the ICT (Fraunhofer Institute for Chemical Technology) at Pfinztal, and since then has been very successfully applied in the state of Baden-Württemberg. During the course of a nation-wide extension, a Theoprax® communication center was established at Fraunhofer UMSICHT with the objective to introduce the Theoprax® network in the greater Rhine-Ruhr region.

How does Theoprax® work?

Fraunhofer UMSICHT acts as a regional communication platform in the networking between local industrial enterprises and schools/universities. Interdisciplinary working groups are formed among students to work on problems in the fields of process engineering given by the industrial partners. The workshops are coordinated and tutored by experienced engineering and research staff from the Institute.

What are the benefits of Theoprax®?

Theoprax® gives students an early basic understanding of real world work and helps them develop key practical skills such as creativity, conflict management, communication and other soft skills. When entering their professional career, students are better prepared and know what is really required in practice. Employers are given an efficient and practical tool to select and recruit qualified future staff.

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Theoprax®

Junior and senior students are being trained in project work

infernum

In collaboration with the FernUniversität Hagen (Open University), a German distance learning institution, Fraunhofer Umsicht has launched the interdisciplinary **distance learning program Environmental Sciences (infernum)** in November of 2000. This four semester course offers updated, practical and comprehensive environmental know-how both in this and related disciplines and is equally designed for engineers and scientists, economists and graduates from humanities and law. The students are trained in interdisciplinary skills, which are indispensable for the solution of complex environmental problems.

infernum has encountered wide-spread interest and acceptance both nation and Europe-wide, for instance in Austria, Belgium and in Switzerland. Students enrolled display a variety of qualifications from different disciplines, ranging from engineering, science and economy, through medicine or theology to educational sciences.

In-house seminars that are regularly organized at Oberhausen, offer the opportunity to meet fellow students and teaching staff, and to deepen the knowledge gained in interdisciplinary workshops and lectures.
In 2001, a total of three meetings were held, that have been met with great success among students, teachers and organizers.
Since the winter term of 2001/2002, the Hochschulgesellschaft Oberhausen e. V. has introduced the award of two scholarships for the infernum program. The scholarship holders stand out by high scientific qualification and a special personal or professional commitment to environmental protection and to sustainable development. The Hochschulgesellschaft e. V. is going to support another two scholarships for the summer term of 2002.

Interdisciplinary cooperation is a prerequisite for sustainable environmental protection

The innovative training model infernum is a significant building block of the scientific communinity of Oberhausen, paving the way to a region-wide development in the field of science and learning networking.

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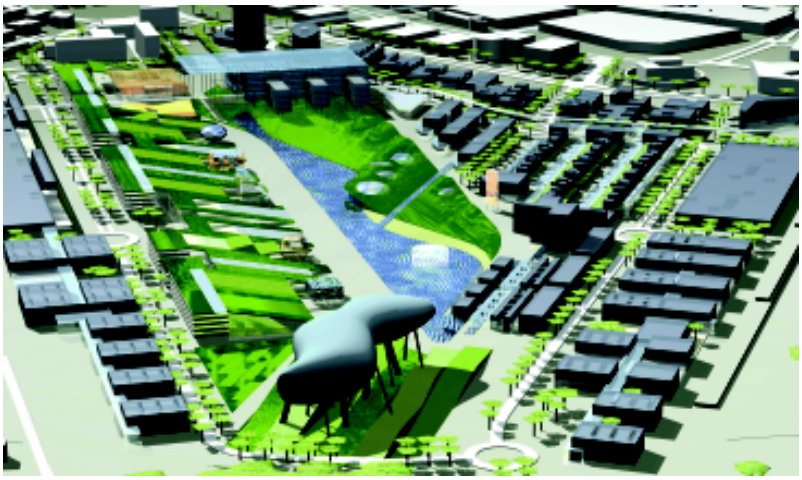
*O.*vision Theme Park

Edutainment or Fraunhofer makes technology fun

On the premises of the former Thyssen steel mill Ost, an area of about 65 hectares adjacent to Fraunhofer UMSICHT, a new future park named "*O.*vision" is planned to be built by the city of Oberhausen. The central section will be occupied by the *O.*vision theme park offering the visitor modern, unprecedented attractions in the field of future technological and scientific developments. The effects of technological progress on our industrial society, future living and working conditions are presented in scenarios, which are easy to approach and fun to experience.

General view of the planned *O.*vision theme park, in the foreground the Glass Giant figure as landmark, the former steel mills now serving as bus and streetcar station in the background, surrounded by theme zones, industrial and trade areas, scientific institutions and modern residential units.
Source: OX2 architekten, Aachen



Fraunhofer UMSICHT, one of the institutes of Europe's largest contract R&D organization, is participating in the conceptual planning and the subsequent implementation of the core project, the "Glass Giant", which represents the visual landmark and central attraction of the park. This eye-catching, huge and impressive glass figure of a human body is intended to demonstrate and visualize the functions of the human body, medical interventions, analogous technological systems.

A working group consisting of eight institutes was established for the remaining eight theme zones: The IAO coordinates the theme work, civil society and living conditions, the IGD the area of virtual worlds, the ILT micro- and nanotechnologies sector, the IPA works on the robotics section, the ISST is responsible for the information, know-how and communication fields, the ITA has taken on the life sciences and collaborates on the Glass Giant development, the IML is designing the pavilion "automotive mobility", and UMSICHT is responsible for the sector of environment, energy and water. In the advanced project stages, nearly all Fraunhofer Institutes can contribute to the realization of the project.

Among the special assets of this project is the proximity of the theme park to industrial zones, scientific institutes as well as modern residential zones, supporting the idea of "public understanding of science". This project is a milestone in the structural transformation of Oberhausen, encouraging new standards for the networking between science, business and tourism sectors in the region.

Contact

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Dr.-Ing. Hartmut Pflaum
(02 08/85 98 -11 71)

Environment and Leisure

Environment and leisure

Environmental protection and responsible use of finite resources are becoming major priorities for the operators of leisure and entertainment centers, both for reasons of efficiency and for image improvement. Business fields such as customer acquisition and public acceptance of entertainment centers are increasingly influenced by environmental protection aspects.

Environmental protection is increasingly important for entertainment parks

This is the challenge which the operators of large entertainment centers have to address. Fraunhofer UMSICHT offers concepts on how to meet the specific requirements of particular leisure parks. Interdisciplinary expertise in waste, water, and energy management as well as fire prevention allow for customized solutions to be delivered to the customers from one source.

Detailed studies on various facilities of leisure and entertainment parks including theme parks, restaurant areas, hotels, green areas, and parking zones, will be conducted to assess the requirements of supplied resources (water, electricity, heat and cold) as well as to identify the amounts of waste (solid materials and sewage) that requires disposal.

Based on the results, conventional, innovative and regenerative technologies will be analyzed with respect to environmental compatibility, for marketing potential, and last but not least economics and funding opportunities in order to identify and utilize synergistic relationships.

Through the implementation of environmental concepts in parallel to the development of the entertainment institution, specific environmental concepts are iteratively developed that ensure integration into the operation process, take specific on-site boundary conditions into consideration and, thus, prevent add-on solutions.

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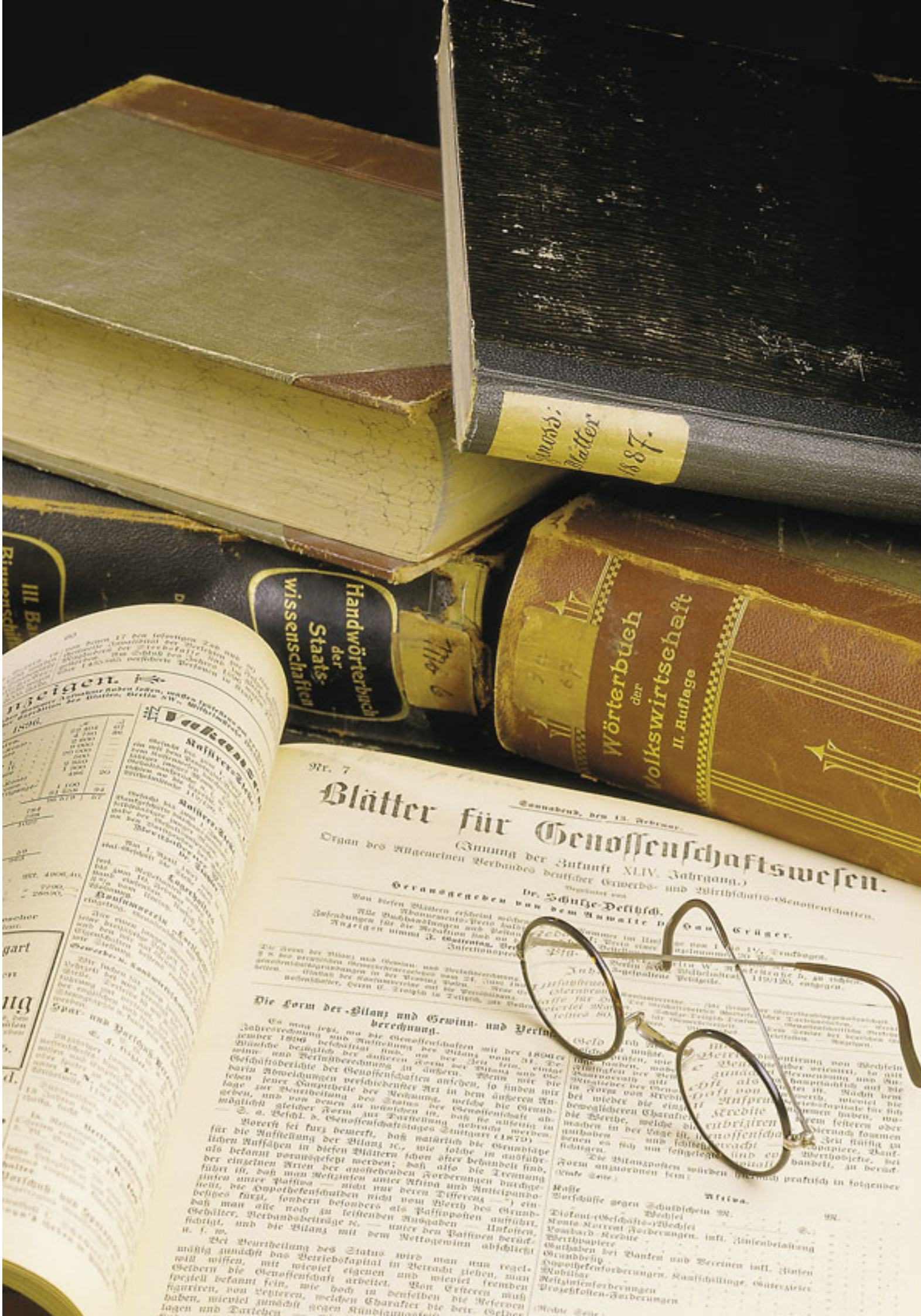
Dipl.-Ing. Ulrike Wilms
(02 08/85 98 -11 42)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Organ des Allgemeinen Verbandes deutscher Gewerbe- und Wirthschafts-Genossenschaften.
Herausgegeben von dem Anwalte
Dr. Schulze-Delitzsch.
Die Form der Bilanz und Gewinn- und Verlust-Berechnung.
Aktiva.
Passiva.

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 publication list 2001.

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Simulation and Optimization of Biological Processes in Stirred Tank Reactors (European Congress on Biotechnology (ECB10) <10, 2001, Madrid>)
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Selected Clients and Contacts

Bewag-Aktiengesellschaft, Berlin

Abfallentsorgungs- und Verwertungsgesellschaft Köln mbH, Cologne

ACCESS e. V., Aachen

ADAC Test und Umwelt, Munich

ADSOCA AG, Marl

AEG-SVS-PSS GmbH, Warstein-Belecke

AG Solar NRW, Jülich

AiF, Arbeitsgemeinschaft industrieller Forschungsvereinigungen "Otto von Guericke" e. V., Cologne

Air Products PLC, Basingstoke, Hampshire, Great Britain

Akzo Nobel Central Research b.v., Arnhem, Netherlands

Andritz AG, Viennan, Austria

Ansaldo Fuel Cells SpA (AFCo), Genova, Italy

AKZO NOBEL, Sweden

ALSTOM Ballard GmbH, Frankfurt

ALSTOM Energietechnik GmbH, Bremen/Dortmund

Aspen, Great Britain

ATEC Dr. Mann GmbH, Obrigheim

A-TEC Anlagentechnik GmbH, Duisburg

ATT Automationstechnik GmbH, Lutherstadt Wittenberg

Avista Resources Inc., Dallas, Texas, USA

AWAS-Ihne GmbH, Wilnsdorf

Axima Refrigeration GmbH, Lindau/Bodensee

Babcock Borsig Power Energy, Oberhausen

Babcock Borsig Power Environment GmbH, Gummersbach

Balcke-Dürr Energietechnik GmbH, Oberhausen

BASF AG, ZA/Technische Entwicklung, Ludwigshafen

Bauordnungsamt Aachen, Aachen

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Bayer AG, Leverkusen

Bayer 04 Leverkusen Fußball GmbH, Leverkusen

Behr & Partner, Schwerte

Benteler AG, Paderborn

Bergamt Recklinghausen

Bezirksregierung Arnsberg, Abteilung Energie, Arnsberg

Boehringer Ingelheim Pharma KG, Ingelheim

BLB NRW, Bau- und Liegenschaftsbetrieb NRW Düsseldorf, Düsseldorf

BRZ, Bodenreinigungszentrum Herne GmbH & Co. KG, Herne

BTU, Brandenburgische Technische Universität, Cottbus

Bundesministerium für Wirtschaft und Technologie, Bonn/Berlin (BMWI)

Byk-Gulden Lomberg GmbH, Konstanz

C.A.R.M.E.N. e. V., Straubing

Ciba Spezialitätenchemie Lampertheim GmbH, Lampertheim

CP Kelco Germany GmbH & Co. KG, Hamburg

CPM Europe b.v., Amsterdam, Netherlands

Danfoss Water Valves – Socla Chalon/Saone CEDEX, France

DBBauProjekt GmbH, Cologne

DBU, Deutsche Bundesstiftung Umwelt, Osnabrück

Delft University of Technology, Laboratory for Process Equipment, Delft, Netherlands

Degussa-Hüls AG, Frankfurt

Degussa-Hüls AG, Hanau-Wolfgang

Degussa INFRACOR GmbH, Marl

DELU, Deutsche Leckageortungs- und Umwelttechnik AG, Düsseldorf

DeLucia, Italienische Feinkostspezialitäten GmbH, Heiden

Deutsche Bank AG, Innovationsteam Umwelttechnologie, Munich

Deutsche Shell Aktiengesellschaft, Hamburg

Deutsche Structured Finance, Frankfurt a. M.

Deutz Energy GmbH, Mannheim

DFG, Deutsche Forschungsgemeinschaft, Bonn

DIL Deutsche Immobilien Leasing GmbH, Düsseldorf

DKR, Deutsche Gesellschaft für Kunststoff-Recycling mbH, Cologne

DLR Deutsches Zentrum für Luft- und Raumfahrt e. V., Cologne

DREWAG Stadtwerke Dresden GmbH, Dresden

DTNW, Deutsches Textilforschungszentrum Nord-West e. V., Krefeld

EdF, Electricité de France, Paris, France

EFA, Effizienz-Agentur NRW, Duisburg

EGG, Energieversorgung Gera GmbH, Gera

Ekono Energy Ltd, Espoo, Finland

Empresarios Agrudados, Madrid, Spain

ENA GmbH, Barleben

Energieagentur NRW, Wuppertal

Entwicklungsgesellschaft Neu-Oberhausen mbH – ENO, Oberhausen

ENR Energiegesellschaft nachwachsender Rohstoffe mbH, Dorsten

ENRO AG, Essen

E.ON Engineering GmbH, Gelsenkirchen

ESG Aktiengesellschaft, Linz

Europäische Kommission – Generaldirektion Unternehmen, Brussels, Belgium

EUS GmbH, Gelsenkirchen

EVN AG, Wiener Neustadt

EVO, Energieversorgung Oberhausen AG, Oberhausen

Fachhochschule Emden

Fachhochschule Münster

Fachhochschule Niederrhein, Krefeld

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Fernwärme Wien Ges.m.b.H., Vienna, Austria

fiatec Filter & Aerosol Technologie GmbH, Mainleus

FKuR – Forschung und Engineering GmbH, Willich

FN, Fernwärme-Versorgung Niederrhein GmbH, Dinslaken

FNR, Fachagentur Nachwachsende Rohstoffe e.V., Gülzow

Ford Werke AG, Cologne

Forschungszentrum Jülich GmbH, Jülich

Freudenberg Vliesstoffe KG, Colmar, France

Framatome ANP, Offenbach

Fritz Winter GmbH, Stadtallendorf

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FVS, Fernwärme-Verbund Saar GmbH, Völklingen

FW-Fernwärme-Technik GmbH, Celle

FZR-Forschungszentrum Rossendorf, Dresden

G.A.S. Energietechnik GmbH, Krefeld

GCT German Carbon Teterow GmbH, Teterow

GEA AG, Bochum

GEA Jetpumps GmbH, Ettlingen

GEA Wiegand GmbH, Ettlingen

GE Bayer Silicones GmbH & Co. KG, Leverkusen

GEF, Gesellschaft für Energietechnik und Fernwärme mbH, Leimen

Gelsenwasser AG, Gelsenkirchen

Gemeinde Greußenheim (Bayern)

Glatt Ingenieurtechnik GmbH, Weimar

GPEC, District Heating Enterprise in Gdansk Ltd, Gdansk, Poland

H. Anger's Söhne GmbH, Hessisch Lichtenau

Hannover Leasing GmbH, Munich

Hansa Consult mbH, Glinde

HdT Haus der Technik e. V., Essen

Henkel KGaA, Düsseldorf

HEW, Hamburgische Electricitätswerke AG, Hamburg

HEZ, Olsberg

Hilstru-Matec GmbH, Willich

Hubert Loick VNR GmbH, Dorsten

H.U.T. Heuwieser Umwelttechnik GmbH, Linsengericht

Hydac Technologie GmbH, Sulzbach/Saar

ICSO, "Blachownia" Institute for Heavy Organic Synthesis, Kedzierzyn-Kozle, Poland

IEA, Internationale Energieagentur, Paris, France

IFI, Institut für Industrieaerodynamik GmbH, Aachen

IHK Aachen, Aachen

IICh, Polish Academy of Science, Institute of Chemical Engineering, Gliwice, Poland

Informatik Centrum, Dortmund

INFRASERV Dienstleistungen Gera GmbH, Gera

Ingenieurbüro Prof. Brachetti, Springe Institut für Markscheidewesen, RWTH Aachen, Aachen

Institute for Environmental Science and Engineering, Singapore

Institute for Refractory Materials, Gliwice, Poland

Interdisziplinäre Dortmunder Energieforschung, IDE e. V., Dortmund

Interseroh, Cologne

IRM Integrated Management Resources Inc., Vienna, Austria

ISL, Industrie Service Lukas GmbH, Duisburg

Isobrugg Stahlmantelrohr GmbH, Lehrte

ITC Jurong Town Corporation, Singapore

IUTA, Institut für Energie- und Umwelttechnik e. V., Duisburg

IVAM, Dortmund

Jenbacher AG, Jenbach

Jenbacher Energiesysteme GmbH, Mannheim

Johnson Controls GmbH, Burscheid/ Grefrath

Jordan University of Science and Technology, Department of Civil Engineering, Irbid, Jordan

KAE GmbH, Bubenreuth

KERM Engineering GmbH, Herne

KFKI Atomic Energy Research Institute, Budapest, Hungary

KIK Kunststofftechnik, Kleinblittersdorf

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Landgericht Heilbronn, Heilbronn

Landratsamt Zollernalbkreis, Balingen

Laserzentrum, Münster

LEM, Ingenieurbüro Last- und Energiemanagement, Leipzig

LUA, Landesumweltamt Nordrhein-Westfalen, Essen

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Thyssen Energie Systeme, Essen

TODA KOGYO Europe GmbH, Düsseldorf

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UDT, Universidad de Concepción, Unidad de Desarollo Tecnológico (UDT), Chile

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Umweltbundesamt, Berlin

UNA, Energie produktiebedrijf Utrecht en Noord Holland, Utrecht, Netherlands

Unikliniken in Bonn, Düsseldorf, Cologne, Dortmund

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von Görtz & Finger Technische Entwicklungsgesellschaft mbH, Oberthingau

VTT Chemische Technologie Prozesse und Umwelt, Finland

WAM Technik GmbH, Hilden

WAT-Membratec Wasser- und Abwassertechnik GmbH & Co. KG, Erkrath

WEIMA Maschinenbau GmbH, Ilsfeld

Westfalia Foodtec GmbH, Oelde

Wuppertal-Institut für Klima, Umwelt, Energie, Wuppertal

Wupperverband, Wuppertal

ZERMA, Zerkleinerungsmaschinenbau GmbH, Sinsheim-Dühren

Patents 2001

Issued Patents:

Process for practical examination of smoke extraction concepts and facilities for buildings as well as device for the realization of the process
(Seifert, Stein, Peukert)

Arrangement of nozzles for the discharge of gas into a container, which is at least partially filled with fine-granulated material
(Balke, Ising)

Demonstration device modelling a living organism
(Weinspach)

Seal for pipe joints
(Wack, Groß, Wodke, Dolfen)

Sealing for pipe joints
(Wack, Wodke, Dolfen)

Arrangement for preventing undesirable pressures when blocking off or throttling the transport of liquid in a pipeline
(Prasser, Schlüter, Dudlik)

Process and device for the production of globular polymer particles
(Groß, Wack, Althaus)

Trademarks:

QUASIL

Human Giant (symbol and word trademark)

Human Life Park (symbol trademark)

WOMS

MOKON

Spin-offs

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
(in formation) software development, system analyses, EDP-consulting

ENR – Energiegesellschaft nachwachsende 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 Forschung und Engineering 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

PSK Engineering GmbH, Willich
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
Expansible 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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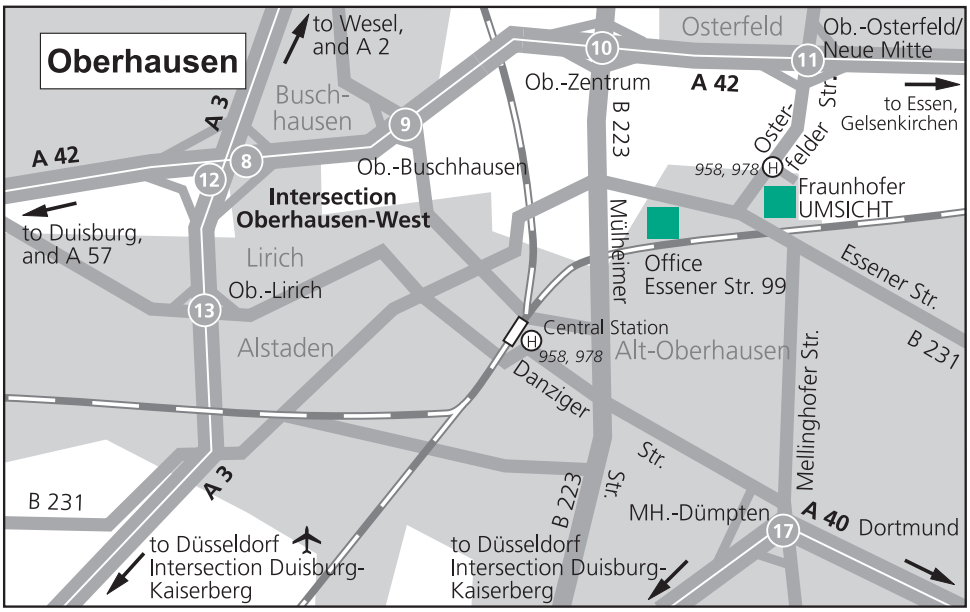

By car

Freeway A 42: Exit Oberhausen-Osterfeld/Neue Mitte. At the end of the exit turn onto Osterfelder Straße towards "Neue Mitte" or Oberhausen-Zentrum/Essen respectively. Follow the road for approximately 1 km. Behind the sign "Fraunhofer UMSICHT" turn left into the parking lot of the institute.

Freeway A40: Exit Mülheim-Dümpten; coming from Dortmund turn right at the end of the exit. At the next intersection turn left onto Mellinghofer Straße and at its end turn left onto Essener Straße. At the next major intersection turn right onto Osterfelder Straße. At the first traffic light turn right into the parking lot.

By train

From Oberhausen Central station to UMSICHT with bus no. 185 (direction Essen Borbeck Bf.), bus no. 957 (direction Kiebitzstraße), no. 958 (direction Spechtstraße), or no. 978 (direction Tackenberg) to bus stop "Osterfelder Straße" (from June 2002 on "UMSICHT")

By plane and train/car

From Düsseldorf Airport take city rail line S1/S2 direction Dortmund Central Station; Get off at Duisburg Central Station and change onto line S2 direction Dortmund and get off at Oberhausen Central Station; to continue see: By train or if you are traveling by car take Freeway A44 from the airport till you reach intersection "Düsseldorf-Nord." Take freeway A52 (direction Essen/Oberhausen). At intersection "Breitscheid" change onto freeway A3 and keep going until you get to intersection "Oberhausen West"; From there turn onto freeway A42 (direction "Dortmund") and take the exit "Oberhausen-Osterfeld/Neue Mitte"; to continue see: by car.

Address

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The Fraunhofer-Gesellschaft

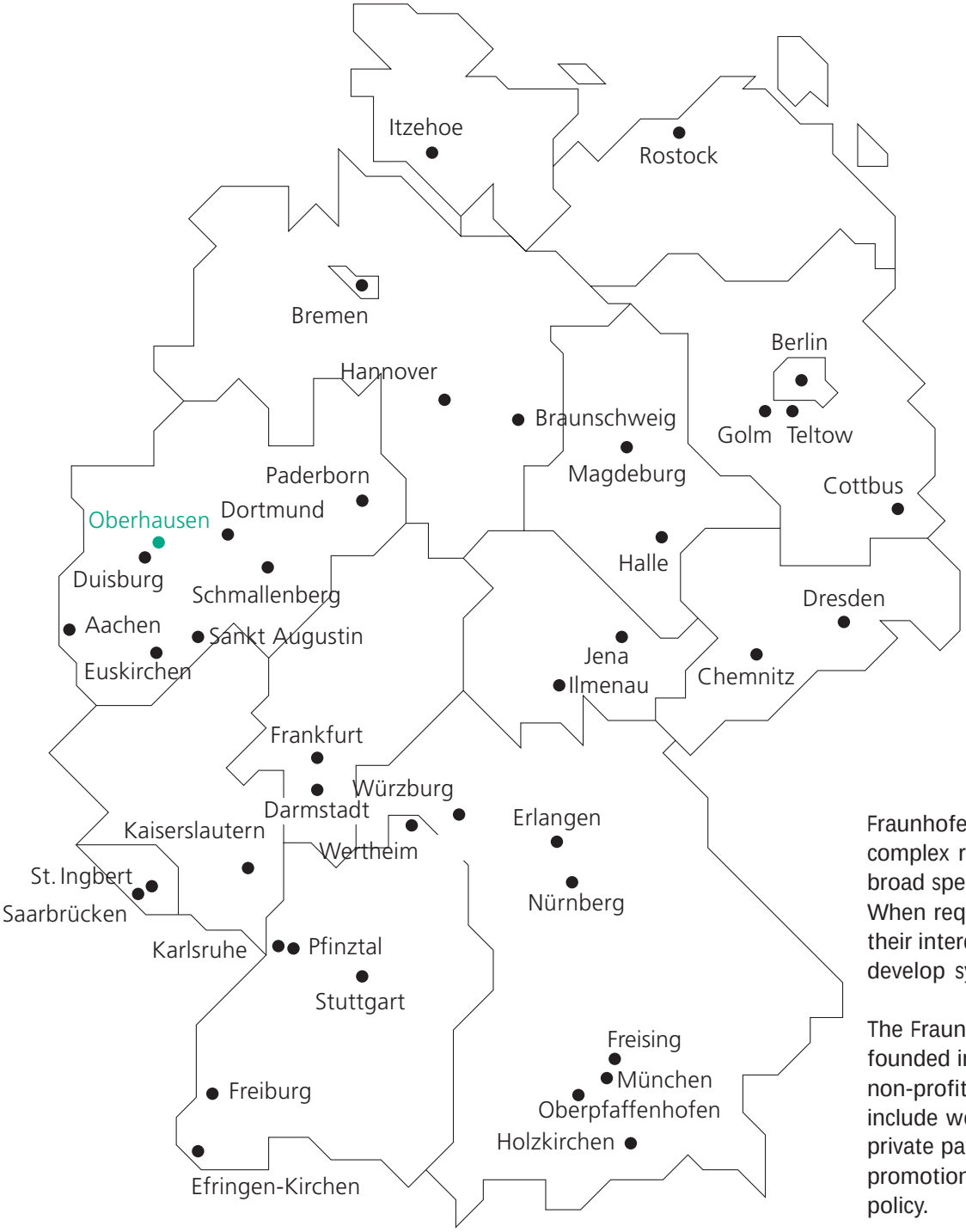
The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is the leading organization for institutes of applied research in Europe, undertaking contract research on behalf of industry, the service sector and the government. Commissioned by customers in industry, it provides rapid, economical and immediately applicable solutions to technical and organizational problems. Within the framework of the European Union's technology programs, the Fraunhofer-Gesellschaft is actively involved in industrial consortiums which seek technical solutions to improve the competitiveness of European industry.

The Fraunhofer-Gesellschaft also assumes a major role in strategic research: Commissioned and funded by Federal and Länder ministries and governments, the organization undertakes future-oriented research projects which contribute to the development of innovations in spheres of major public concern and in key technologies. Typical research fields include communications, energy, microelectronics, manufacturing, transport and the environment.

The global alignment of industry and research has made international collaboration imperative. Furthermore, affiliate Fraunhofer institutes in Europe, in the USA and in Asia ensure contact to the most important current and future economic markets.

At present, the organization maintains 56 research establishments at locations throughout Germany. A staff of some 11,000 – the majority of whom are qualified scientists and engineers – generate the annual research volume of more than 900 million €. Of this amount, over 800 million € is derived from contract research. Research contracts on behalf of industry and publicly financed research projects generate approximately two thirds of the Fraunhofer-Gesellschaft's contract revenue. One third is contributed by the Federal and Länder governments, as a means of enabling the institutes to work on solutions to problems that are expected to attain economic and social relevance in the next five to ten years.



Fraunhofer scientists specialize in complex research tasks involving a broad spectrum of research fields. When required, several institutes pool their interdisciplinary expertise to develop system solutions.

The Fraunhofer-Gesellschaft was founded in 1949 and is a recognized non-profit organization. Its members include well-known companies and private patrons who contribute to the promotion of its application-oriented policy.

The organization takes its name from Joseph von Fraunhofer (1787-1826), the successful Munich researcher, inventor and entrepreneur.

For any further information you may wish, please check the corresponding box and mail or fax us a copy of this page.

Further information is also available at www.umsicht.fhg.de

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Fields of interest

Environmental Technology

- ☐ New Processes
- ☐ Particle Technology
- ☐ Adsorption/Gas Cleaning
- ☐ Waste Technology and Management
- ☐ Plastics Technology
- ☐ Bioengineering
- ☐ Water Treatment/Membrane Technology
- ☐ Special Polymeres
- ☐ Chemistry, Biology, Analytics

Safety and Process Technologies

- ☐ Safety Analysis and Design
- ☐ Dynamic Processes
- ☐ Software Development
- ☐ Fire Safety and Explosion Protection
- ☐ Technical Information Management
- ☐ Pipeline Technology

Energy Technology

- ☐ Use of Lean Gas
- ☐ District Heating/Combined Heat and Power
- ☐ Cold Supply
- ☐ Energy Management
- ☐ Energy from Biomass
- ☐ Fuell Cell Systems
- ☐ Plant Systems Engineering

Knowledge- and Technology Transfer

- ☐ International Project Development
- ☐ Training Center
- ☐ Project Funding/ Spin-offs
- ☐ Innovation Management

Your personal data

Name, first name _____

Title _____

Company _____

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country _____

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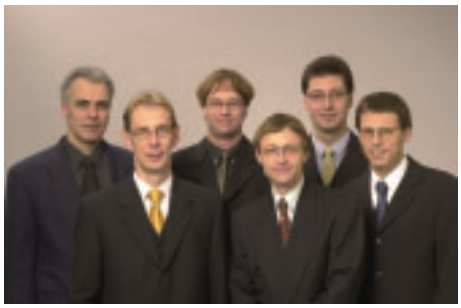

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