FIW Annual Report 2015

FIW Munich

Forschungsinstitut für Wärmeschutz e.V. München

Content

Dear members and friends of our institute,

2016 could and should be a special year for the energy revolution: The state Energy Conservation Act (Energieeinsparungsgesetz – EnEG) is turning 40. 40 years ago, when it seemed that energy was endlessly available, energy efficient buildings were unheard of. The low energy prices guaranteed warm and cozy houses, even in the harshest of winters. The oil price shock of the mid-1970s kickstarted the rethinking process. People recognized that buildings are responsible for a large proportion of energy consumption, as well as a considerable degree of climate change.

In its first edition in 1976, the Energy Conservation Act (EnEG) was the basis of the first Thermal Insulation Regulation (Wärmeschutzverordnung) in 1977. To date, the aim of the EnEG is to ensure that buildings save energy and only consume as much energy as is necessary in each case, so as to utilize the building in the most appropriate manner. In the first edition, it focused particularly on the insulation of the building shell, as well as efficient systems engineering and its operation. As a result, with the assistance of the FIW München, requirements concerning the thermal insulation of new buildings were introduced. The first Thermal Insulation Regulation and the revisions that occurred in the following years, as well as the introduction of the EnEV in 2002, have had a lasting influence on the construction of 1.75 billion m^2 of living space in Germany (approximately 40 % of the country's entire living space). The energy quality of buildings has risen considerably since the introduction of the Thermal Insulation Regulation at the end of the 1990s, and is a great improvement on the quality of pre and post-war buildings. Without these amendments to thermal insulation - as controversial today as they ever were - energy consumption for heating systems and hot water in residential building stock would be approximately 250 TWh higher per year. With the increasing demands on the energy efficiency of buildings, the last decades have seen the creation of materials that are especially efficient for thermal insulation, the expansion of the scope of application and the development of new processing techniques - all with the active assistance of the FIW München.

Despite this incredible success of 40 years of energy efficient construction, we have only just begun. If you compare the distribution of building stock with the corresponding energy status, you will see that 65 % of buildings in Germany still require restoration. The proportion of external façades that have been insulated at a later date is a meager 30 %. Based on a technically feasible saving potential, in the entire building sector (residential and non-residential buildings) there is a roughly estimated minimum consumption of around 350 to 400 TWh per year. This increase in efficiency is of course only retrievable if all possibilities are fully utilized, such as sufficient insulation of the building shell, window modernization and the use of modern techniques.

This makes it strikingly clear that the targets created by the German federal government in its energy concept – which should be fully realized by 2050 – concerning the reduction of primary energy consumption in the building sector by 80 % in comparison to the 2008 figure, cannot be achieved with the energy efficient construc-

1 Editorial

tion of new builds alone. It therefore requires a systematic restoration of building stock by utilizing all practical active (building services) and passive (insulation) measures in an approach which is both open to various technologies as well as being economical.

The next stage of national implementation is now pending. In order to implement it, the EnEG, the Energy Saving Regulation (Energieeinsparverordnung – EnEV) and the Renewable Energy Heat Act (Erneuerbare-Energien-Wärmegesetz – EEWärmeG) should be structurally redesigned and brought together in a single regulatory framework. The aim is a coordinated regulation system for the energy requirements of new buildings, existing buildings and the utilization of renewable energy sources for the supply of heat. The EnEV 2017 serves to implement the newly prepared EU Directive concerning the total energy efficiency of buildings and should promote the energy revolution in Germany. However, future requirements must be clarified. In doing so, it is important not to be misled by the current low energy prices.

When discussing the new version of the EnEV, it is crucial to remember that requirements will only change in new builds. The real challenge, however, is the existing stock of 18 million buildings. Here, everything complies with the 2009 requirements. A public discussion about a future EnEV in new builds may also have a negative impact on the opinion of many investors with regard to urgently needed restoration, thereby further decreasing the rate. The threat that such a discussion may pose to an energy revolution in the building sector would set Germany back by years in its international obligations and must be avoided at all costs. A renunciation of the EnEV would be fatal.

We have known for many years that the thermal insulation of operational plants by means of considerably increased temperature differences is an effective measure in increasing energy efficiency. The Federal Office of Economics and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle – BAFA) has taken this idea on and, with its new program, promotes the use of highly efficient cross-section technology, and the insulation of industrial plants and plant components from May 2016. The more pillars of saving potential that are used alongside those in the building, the more sustainably and stably the energy revolution process can proceed.

As a result of this and the fundamental amendments to German Construction Law, and thereby to general building approvals, new challenges will emerge in the future in terms of our institute's mission statement and work assignment, for which we are fully prepared. Our institute is deemed a neutral moderator which is open to various technologies. We are taking a leading role in the discussion and further development of well thought-out methods in the field of energy efficiency in new and old buildings, in plant technology and non-residential buildings.

Yours,

Klaus-W. Körner
Executive chairman
of FIW Munich

Yours,

Prof. Dr.-Ing. Andreas Holm
Managing institute director

FIW Munich at a glance

The Institute pursues exclusively non profit purposes within the meaning of the section "Tax-Deductible Purposes" of the German Tax Code. The purpose of the Institute is the promotion of scientific research in heat insulation.

The purpose of statutes is realized by the following in particular:

- Researching the thermal and mass transfer laws, especially the scientific principles concerning insulation against heat and cold
- Disseminating this knowledge
- Thermotechnical testing of construction and thermal insulation materials and the constructions made from them (practical designs)
- Cooperation with heat economy associations, technical associations and scientific institutes

The structure and organization of FIW Munich is oriented to the business areas as well as to the classic core competencies. FIW Munich core competencies and business areas cover a wide spectrum. They cover, amongst other things, laboratory tests, open-air tests, development of measurement equipment, in-situ demonstrations, studies, further education and standardization.

Managing institute director:
Prof. Dr.-Ing. Andreas Holm

Research and development on thermal insulation	Service	Certification	Surveillance / Testing	
Christoph Sprengard	Quality Management: Ralph Alberti Equipment building: Michael Guess Administration: Rolf Opp	Wolfgang Albrecht	Claus Karrer	Roland Schreiner


Christoph Sprengard


Wolfgang Albrecht


Claus Karrer


Roland Schreiner

In accordance with the national building regulations and the EU Construction Products Regulation CPR), senior staff of the certification, surveillance and testing body is, of course, professionally released from the duty to follow Institute's instructions within the scope of their activities.

Core competencies and business areas

Testing, monitoring and certification

- **Holistic evaluation of the building shell**
- **In all questions pertaining to**
  - thermal insulation
  - moisture protection
  - fire protection
  - stability
  - material composition
- **Development of testing standards, material standards, guidelines and worksheets**

Research and development

- **Basics of thermal insulation and moisture protection as well as construction chemistry**
- **Testing of technologies and new materials for improving energy efficiency**
- **Effect of determining factors**
- **Durability of materials and systems**
- **Initial research into construction material and construction system development**
- **Energetic optimization of the complete building system**

Transfer of knowledge and technology

- **National and international standardization**
- **Member of various expert committees**
- **Publications and lectures**
- **Realization of training sessions and symposia**
- **Development of measurement devices and testing equipment (scientific system and equipment building)**

Building industry

Insulation of industrial systems and in industrial construction

Transport and logistics

Core competencies and business areas

1. Testing and Surveillance body

In the national conformity assessment of building products according to the Building Codes of the German Federal States (Landesbauordnung LBO), the tasks are allocated to a testing, surveillance and certification body. FIW Munich laboratory assumes the activities of testing and surveillance body for thermal insulation materials.

In this case surveillance not only means the formal auditing of production processes, but professional supervision and support of the implementation of normative requirements and the realization of factory production control. With its comprehensive, standardized monitoring of the majority of manufacturing factories of insulation products, FIW cares about high-end building products for end users, and fair market conditions for the producers. Currently FIW is auditing approx. 250 national and international plants for the building industry.

The target of FIW's laboratory is to offer all the tests, relevant to insulation products, or, in exceptional cases, to procure them in cooperation with other laboratories. The decades of experience of Europe's biggest laboratory for insulation products are being integrated into the relevant product standards through collaboration with national and international committees. In return, new test methods are being implemented at FIW Munich, timely and in a competent fashion, to offer a certificate of suitability for the manufacturer's products.

FIW Munich is a national and European (Notified Body) testing laboratory, acknowledged and accredited according to EN ISO/IEC 17025. Its exceptional expertise is demonstrated by its leading collaboration with the Lambda Expert Group for the voluntary European certification mark (CEN Keymark), where registered laboratories for the determination of thermal conductivity of insulation products audit each other and define the measurement accuracy by round robin tests. In the area of technical insulation products, the properties that are in focus of the Laboratory Group are extended to the determination of the maximum service temperature and the water-soluble chlorides. We are particularly proud to have found comparative insulation material (expanded glass granulate) to protect the European level of thermal conductivity at higher temperatures. The institution of a surveillance body does not provide conformity assessment of building products according to the European Construction Products Regulation (CPR). All tasks are assumed by a certification testing body; responsibilities of the national surveillance body, i.e. auditing of manufacturing plants and sampling products, will be assumed by the certification body. However, it has the option to entrust other bodies, for example the testing body, with certain tasks.

The staff responsible for the supervision of insulation manufacturers are thus often independently active as employees of the surveillance body according to the LBO, and on behalf of the certification body according to CPR in the same manufacturing plant and in relation to the same insulating material. However, they are always competent partners for all questions regarding quality assurance and attestation of conformity of insulating products.

The FIW laboratory provides thermal and mechanical tests in the area of "technical insulation" within an extended temperature range between -180 °C and +1000 °C. The laboratory tests, conducted according to European test standards, are complemented by recording of influencing factors on application-oriented insulation systems under practical conditions, for example on boiler walls, pipes or under vibration load. Besides contract testing for all technical insulation products, the active organisation of the European voluntary quality control (VDI/Keymark) is an important service we offer our customers. Taking part in round robin tests is a firm component of the activities performed by accredited laboratories.

An energetic examination of technical insulation systems through detailed investigation using three-dimensional finite element modeling, and the opportunity to calculate thermal and cold insulation according to VDI 2055 Part 1 "Calculation Rules", lead to statements and classification of energy efficiency of industrial plants and building equipment. Application-oriented insulation system checks, conducted simultaneously, also provide fail-safe technical data, which are essential for the energy assessment of insulation systems.

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In the fiscal year 2015, FIW was involved in knowledge transfer in the field of heat and cold insulation. The trainings conveyed calculation basis for the design of technical insulation systems. The basic documents in the field of "energy efficiency of industrial installations" are nearing completion in the VDI 4610 guideline committee.
VDI changed the guideline committee for the revision of VDI 2055 Part 1 "Thermal insulation of operational installations in industry and in building equipment – calculation rules" in a technical committee "Thermal insulation". The work was consistently continued.

In 2015, many testing facilities were modernized and further testing capacities were created for the determination of long-term creep behavior (see reports under "new testing facilities").

The introduction and consistent development of modern database system "eGECKO" at the Institute for the management of test results and product information is the basis for the implementation of voluntary European certification programs. Our team was reinforced by Anatoli Manski, a master of materials science, who supports the testing facility in the coordination and implementation of test runs. Karin Wiesemeyer came back from maternity leave in August 2015, and is working again in the "technical insulation systems" department. Ralph Alberti will assume tasks in the certification authority of the institute in the future.

2. Certification

In order to further strengthen the public perception of important cornerstones – independence and neutrality – of FIW Munich, and to make them visible to the outside, a number of measures were implemented in the organization and in the interaction between association committees:

- The operational structure of FIW Munich (organisation chart) was clearly grouped and reorganized.
- The research department was decoupled personally and organizationally from the FIW's certification, inspection and testing activities.
- The certification, inspection and testing bodies operate as independent organizational units.
- The certification, monitoring and testing department managers and their deputies are released from the duty to follow technical instructions of the Institute management, the Management Board and the Scientific Advisory Board.

On 23.07.2015, FIW München was accredited as a certification authority according to ETAG 004 (guideline for external ETICS with plaster layers), and for voluntary certification schemes relating to thermal insulation materials. n 25.09.2015, the Institute was notified according to the European Building Regulation (EU BauPVO). From 1 December 2015, in addition to its registration as a laboratory, FIW Munich has been recognized as a certification body according to the voluntary European Keymark certification system. This completes our range of voluntary certification systems.

Intensive discussions were held with insulation manufacturers and associations to implement a voluntary external supervision system for the individual insulation types, because the Deutsches Institut für Bautechnik (DIBt) is not entitled to issue building approvals for European standard insulation materials following the European Court of Justice (ECJ) ruling from 16 October 2016. To prevent a loophole in this area, and to offer the consumers and users of insulation the same high quality level as in the time of the quality control seal according to the general building authorizations, voluntary certification programs for all types of insulation materials are being developed at the moment. The certification program and the advanced certification program for ETICS insulation materials made of expanded polystyrene (EPS) are already available. Other voluntary certification programs will follow shortly.

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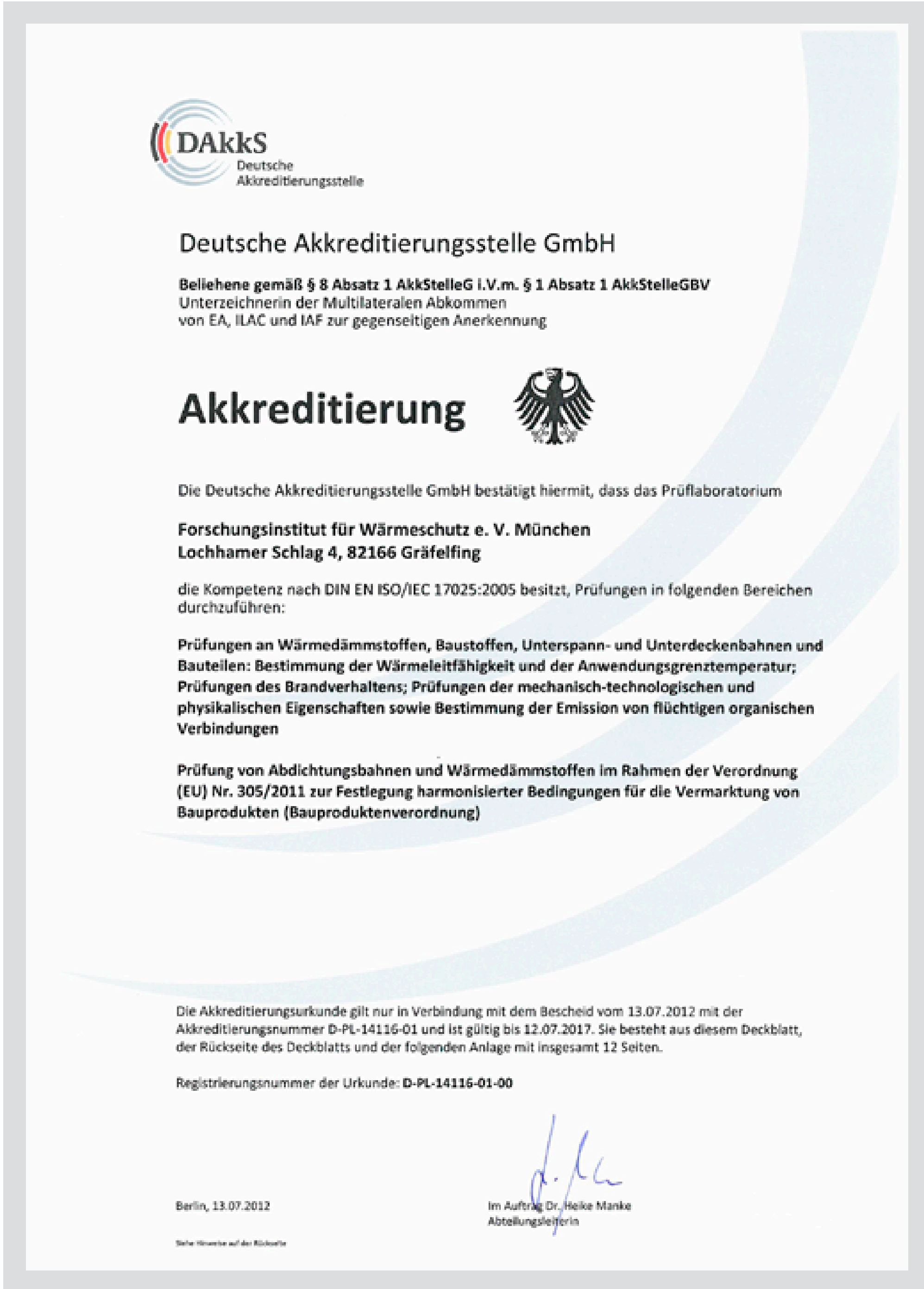

DAkkS Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

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

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

Forschungsinstitut für Wärmeschutz e. V. München
Lochhamer Schlag 4, 82166 Gräfelfing

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

Prüfungen an Wärmedämmstoffen, Baustoffen, Unterspann- und Unterdeckenbahnen und Bauteilen: Bestimmung der Wärmeleitfähigkeit und der Anwendungsgrenztemperatur; Prüfungen des Brandverhaltens; Prüfungen der mechanisch-technologischen und physikalischen Eigenschaften sowie Bestimmung der Emission von flüchtigen organischen Verbindungen

Prüfung von Abdichtungsbahnen und Wärmedämmstoffen im Rahmen der Verordnung (EU) Nr. 305/2011 zur Festlegung harmonisierter Bedingungen für die Vermarktung von Bauprodukten (Bauproduktenverordnung)

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 13.07.2012 mit der Akkreditierungsnummer D-PL-14116-01 und ist gültig bis 12.07.2017. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 12 Seiten.

Registrierungsnummer der Urkunde: **D-PL-14116-01-00**

Berlin, 13.07.2012

Im Auftrag Dr. Heike Manke
Abteilungsleiterin

Siehe Hinweise auf der Rückseite

↑ *Accreditation certificate according to DIN EN ISO/IEC 17025:2005*

↑ *Modern facade design with ETICS*

3. Research and development on thermal insulation

The department's core competency is the hygrothermal optimization of insulation and construction materials and of building components and insulation structures. The continued development activities are increasingly being carried out through calculations and simulations by means of modern computer software. The quality of these calculations depends very much on the degree of accuracy and reliability of the material data, determined in measuring setups. The "Research & Development" department has access to high-quality testing equipment and cutting-edge test methods to determine thermal transition and moisture content. The simulations with components and construction units can be verified true to scale by tests on entire structural components, like facade elements, windows, doors, and walls.

A particular strength of the "R&D" department lies in the flexible combination of calculation, simulation, and laboratory testing. Especially for new insulation materials and construction product, like vacuum insulation panels (VIP), thermal materials based on aerogel and microporous materials (APM "advanced porous materials"), moisture adaptive vapour barriers, low-emission coated insulation foils, or masonry blocks filled with insulation material, there is often no reliable material data available to be used as a basis for the calculation. The "R&D" department defines these material values as a basis for calculative investigations of the product, and accompanies the producers on their way to the market. The department's hygrothermal know-how is also available for branches outside the construction sector. Planners and manufacturers of chemical and power plant systems, fridges and freezers, AC systems, transport containers and vehicles make use of our

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savvy experts, in order to optimize the thermal behavior of their products. Increasing or sinking temperatures often make it necessary to carry out transient calculation, or to analyze the energy demand of systems using dynamic simulations. In many cases, tests under realistic moisture conditions are necessary to analyze moisture distribution in systems, and to evaluate the extent of the damage. These laboratory tests complement, for example, studies on on-site building constructions within the framework of a monitoring of already existing and newly constructed buildings or systems.

In research, the classical questions about structural characteristics concerning heat and moisture transfer are being supported in the same way as the further development of products and components and the application-oriented testing of individual components. Increasing energy efficiency of industrial systems and of the existing building stock, and energy-efficient new construction are the key elements for a successful energy revolution. The ambitious energy saving targets of the federal government cannot be achieved without reducing the heat loss of existing buildings.

The "R&D" department accompanies the entire value added chain in the construction, from raw material to component, to the complete thermal insulation building shell. A holistic view takes into account the location, the climate, and even the user behavior of the residents to gain reliable results for a long-lasting functionality of constructions and restoration measures.

In the fiscal year 2015, the department "Building physics & Components" was renamed into "Research and development in heat insulation" in order to accentuate the recent focus on research also in the name, and to better communicate the separation of the research activities of the Institute from the building inspection tasks of testing, monitoring, and certification also to the outside. The research projects on "Energy Efficiency Improvement with interior insulation systems", commissioned by the German Federal Ministry for Economic Affairs and Energy (BMWi), which were already approved at the end of 2014, and were funded by the Projektträger Jülich (PTJ), and the cooperation on the emerging IEA Annex 65 "Long Term performance of Super Insulating material SIM", which is also financially supported by PTJ, were successfully started, and proceed according to the plan (see section "Ongoing projects"). Moreover, a number of small and large projects were again processed on behalf of customers in 2015. The research project on the use of aerogels and Advanced Porous Materials (APMs) in construction, which was applied for in the autumn of 2014, was authorized in December 2015. The project is funded by the research initiative "Future Building". The project is presented in Chapter 5. Efficiency in planning and implementation of renovation measures is increasingly becoming the focus of public interest. The "R&D" department started already in the previous year to establish the suitable know-how for assessing energy measures from an economic perspective, which is reflected in the first successful projects (efficiency of thermal insulation measures, commissioned by the GDI), and other projects and publications. Some ongoing projects are also described in Chapter 5.

Personnel development

The number of employees has increased from 61 to 64 core staff (full-time equivalent) in comparison with the previous year. Together with temporary employees, 66 persons worked for FIW Munich at the end of 2015.

There were the following service anniversaries, new and leaving employees:

Service anniversary

5 years of service
Stephan Guess
Stefan Klasche
Barbara Kuttner
Tobias Timmermanns
Jens Trommer

20 years of service
Rainer Böttner
Peter Eckart

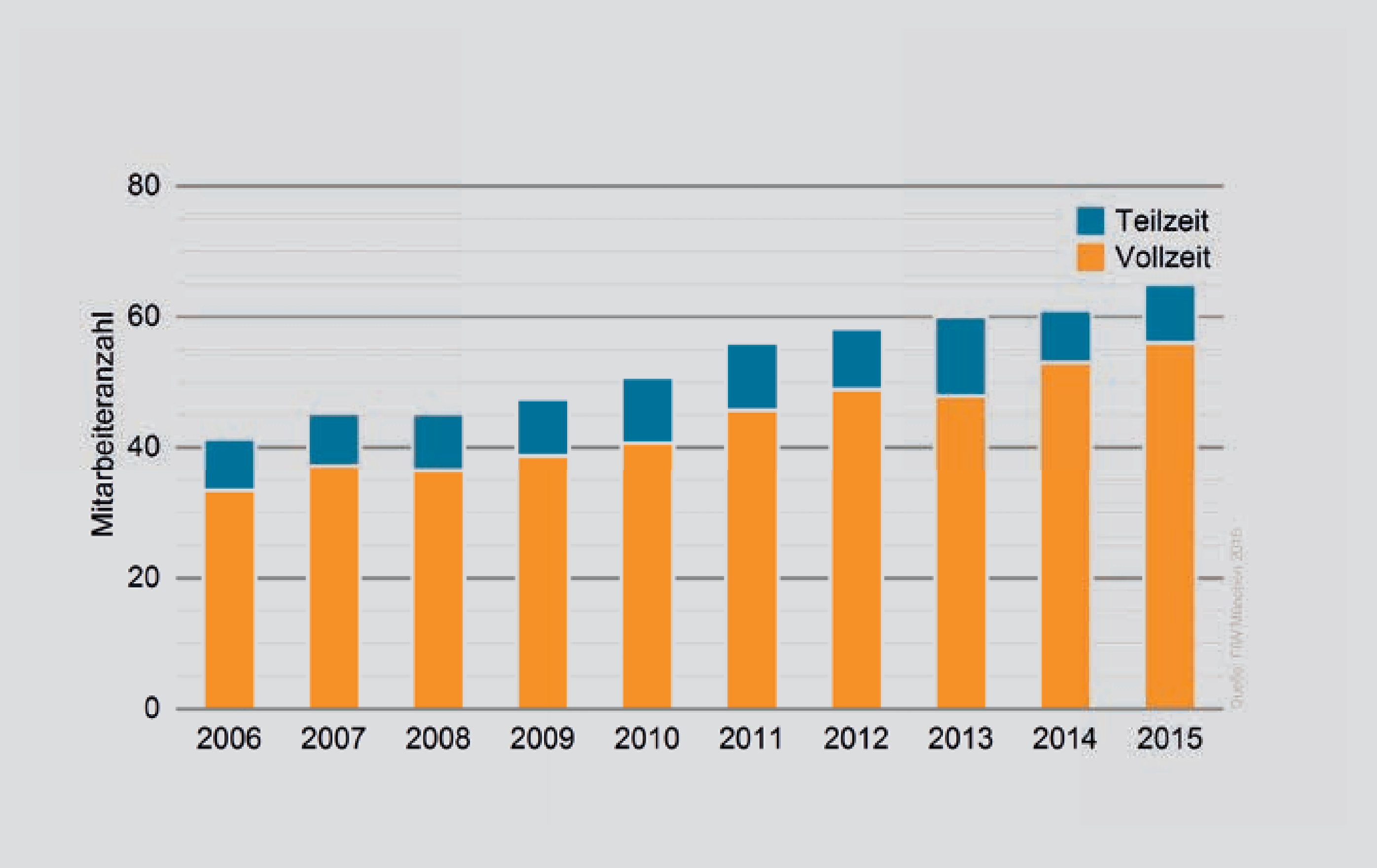
Staff changes at FIW Munich

Entries

Melanie Jähne	1 September 2015
Joachim Jahn	1 July 2015
Anatoli Manski	4 May 2015
Heike Richter	1 July 2015
Dr. Andreas Schmeller	18 May 2015

Retirements

Winfried Eiche	31 January 2015
Rainer Künzl	31 May 2015
Heike Meyer	15 February 2015
Johannes Uhrhan	31 October 2015



↑ *Employee development since 2006*

Financial development

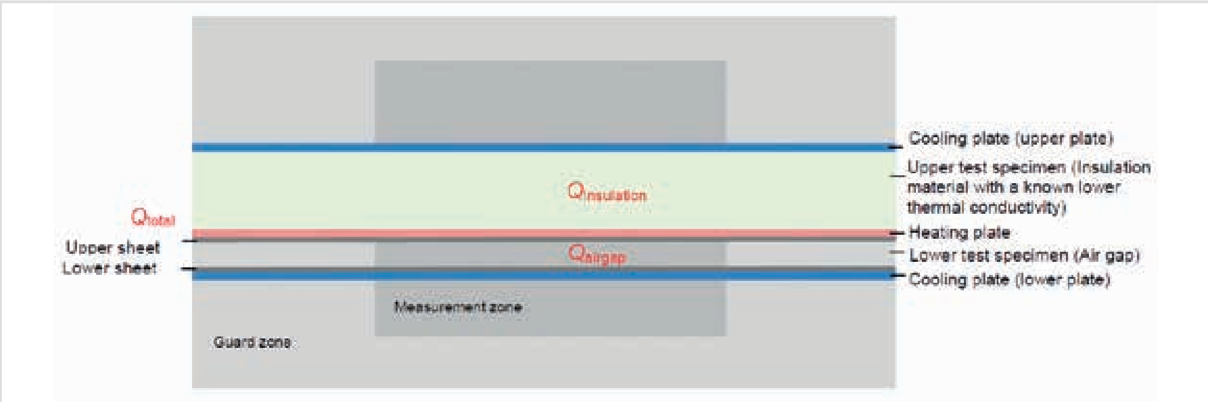
The growth in the HR department is also reflected in the institute's overall performance. Revenues increased to 8.67 million Euro in 2015. The sales volume has increased by more than 128 % since 2000. Positive results with simultaneous revenue increases have been constantly achieved since 2008. This is primarily based on the fact that the testing and monitoring activities were significantly expanded. There were multiple committees with manufacturing plants domestically and abroad for a number of new monitoring contracts. This trend is strengthened by increasing product variety, lower thermal conductivity, and greater insulating material thicknesses. Revenues also positively developed as a result of voluntary monitoring systems. Compared to the previous year, investments increased to a total of almost 0.76 million Euro.
Our customers largely come from the German-speaking market. However, the trend is gradually moving towards an international customer structure. In the last 20 years, the percentage of revenues from abroad has almost doubled: Of the revenues from certificates and tests for 2015, 66 % were domestic, 34 % were from abroad. The reason for this is that many customers are monitored by FIW Munich not just from their national factories, but also in their international factories. Furthermore, FIW Munich was able to establish its own monitoring system in several countries, together with partners from industry. In addition, there are also increasing requests for research and development from abroad.

Memberships and cooperations

FIW Munich is a member of the following institutions:

- Allianz fur Gebaude-Energie-Effizienz, geea, Berlin
- American Society for Testing and Materials (ASTM), Philadelphia
- Connect Deutschland e. V., Aschheim-Dornach
- BDI – Initiative „Energieeffiziente Gebäude“, Berlin
- DIN Deutsches Institut für Normung e. V., Berlin
- DKV Deutscher Kälte- und Klimatechnischer Verein, Stuttgart
- DVM Deutscher Verband für Materialforschung und -Prüfung e. V., Berlin
- EAE, European Association for External thermal insulation composite systems, Baden-Baden
- Energy Efficient Buildings Association E2BA, Brussels
- Fachverband Gebäude-Klima e. V., Bietigheim-Bissingen
- Fachverband Luftdichtheit im Bauwesen e. V., Kassel
- Fachverband Innendämmung e. V., Frankfurt am Main
- Forschungsgesellschaft für Straßen- und Verkehrswesen, Cologne
- GRE, Gesellschaft für Rationelle Energieverwendung e. V., Kassel
- Industrie-Förderung GmbH, Berlin
- L'Institut International du Froid, Paris
- Technischer Überwachungsverein Bayern, Munich
- Vereinigung der bayerischen Wirtschaft e. V. (vbw), Munich; (sponsoring member)
- VMPA Verband der Materialprüfungsanstalten e. V., Berlin
- Verein zur Förderung der Normung im Bereich Bauwesen e. V. VFBau, Berlin

There are also cooperation agreements with the Deutsche Energie-Agentur GmbH (dena), Berlin, and the University of Applied Sciences, Munich.



↑ *experimental setup in the two-plate device in accordance with Annex A, EN 1946-2:1999 as a model*

Indirect determination of the emissivity of sheet metal by means of measurements in guarded hot plate according to EN 12667

Roland Schreiner, Karin Wiesemeyer

Annex A of EN 1946-2:1999 describes the method of determining the emissivity of the surfaces of the heating and cooling plates of a two-plate device. This method is used to indirectly determine the emissivity of the surfaces of sheet metal. The figure shows the basic test setup in the guarded hot plate.

A guarded hot plate according to EN 12667 is used to determine the thermal conductivity of construction materials and products. Two test specimens, separated by a heating plate (hot zone), are measured at the same time. There is an upper and a lower specimen. The actual measurement zone is surrounded by a guard zone that creates adiabatic conditions in the measurement zone.

In the indirect determination of the emissivity, a layer of air with adjacent sheet surfaces of the same metal sheet type on both sides is installed as a lower test specimen. The specified air gap thickness is achieved by using spacers. In this air gap, due to the fact that the warmer limit surface is situated on top, the gravity counteracts the force for convective heat flow. A heat transmission only takes place through the thermal conduction of air and through heat radiation.

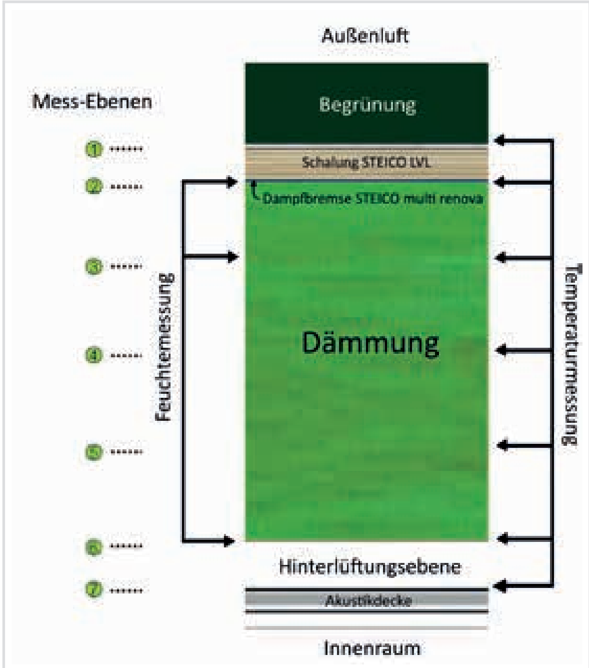
Insulation material with a known lower thermal conductivity is installed as upper test specimen. The measured heat flow is decreased by the heat flow through the upper sample. The heat flow rate across the air gap thus determined is then reduced by the proportion of the thermal conduction of the air, so that the emissivity can be calculated from the proportion of the heat radiation.

The method for the indirect determination of the emissivity using the guarded hot plate according to Annex A of EN 1946-2:1999 is highly dependent on the ability to measure small temperature differences.

Hygrothermal monitoring of upper planking in timber constructions

Max Engelhardt, Christoph Sprengard

Since the summer of 2013, a measurement system designed by FIW Munich has been running in a training room in the new headquarters of STEICO SE in Feldkirchen. It has been continuously recording profiles and curves of temperature and humidity in the outside wall and flat roof structures of a building section. The measurement system includes over 200 sensors. Through a specially developed software platform, the measurement system offers visitors and seminar participants in the training room direct insight into the measurement. A graphical presentation helps to understand the operating principles and features, and structural principles can be reproduced directly on the object by means of specific operations. For demonstration purposes, and in particular to demonstrate the safe functioning of such design variants, different insulation materials were installed in the compartments of the timber frame structures in roofs and walls. In the flat roofs,

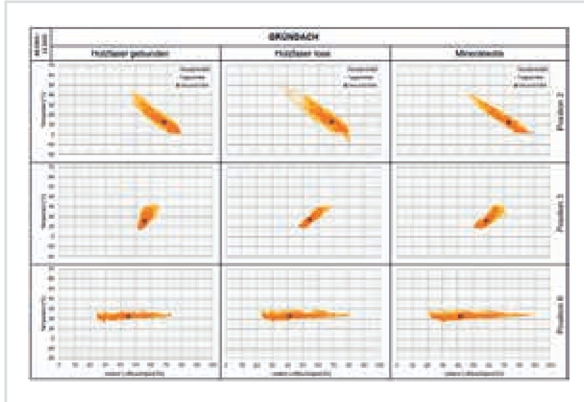


↑ *Arrangement of the sensors in the green flat roof construction*

the versions with light roofing sheets as well as in combination with a green roof do not correspond to the state of the art due to reduced redrying potential compared to design variations with dark roofing membranes. Monitoring should therefore help surveilling and demonstrating the usability of the selected construction.

The collected data underwent a detailed evaluation. The focus with regards to flat roofs was to demonstrate that the annual average humidity in all the component layers ensures a high level of protection against structural damage.

The analysis of all data throughout the recording period shows that the wood fiber insulation ensures unproblematic constructions. The differences between the sorption properties and heat capacity lead to reduced fluctuations in air humidity in the compartments filled with wood fiber insulation. However, a tendency towards slower drying of the wood based insulation materials was found. In terms of the long-term behaviour, it can be stated that no significant hygrothermal differences are found between the tested wood fiber and mineral fiber insulation.
All design variants meet the aspect of usability.



↑ *Air condition as a function of temperature through the relative humidity in the three insulating materials used on various levels (see figure on sensor arrangement) of the green part of the flat roof structure – point clouds for the period from August 2013 to December 2015.*

The study on the durability of mineral wool products in the construction has been completed

Max Engelhardt

The durability of insulation products made of mineral wool has been questioned repeatedly ever since they have been rolled out..

Due to the increasing requirements concerning the modern construction practice, and the growing importance of the ecological balance (life cycle analysis) of buildings and construction products, long-term performance and durability become the even more important. The requirements for durability are more discussed also in product and system standardization at the European level. Thermal insulation plays an important role in the CO_2 savings in buildings. The safety, durability, and cost-effectiveness of measures are the critical criteria for partners and sponsors. Durability is therefore becoming a relevant distinguishing criterion between the products on the energy efficiency market.

A study, which begun in 2012 and was commissioned by EURIMA, the European Mineral Wool Insulation Manufacturers Association, was intended to provide reliable data on the durability of mineral wool products in construction applications. Therefore, high demands were placed on sampling and testing. As an independent and experienced project partner, and as the notified body, FIW was chosen for the testing of building materials, to determine the sample properties that were crucial for durability in its laboratories. The sampling was carried out mostly by third parties.

The field study was intended to investigate buildings with intact constructions. The association's members of EURIMA gathered an selected objects and recruited for participation in the study.

In addition to the building being free of damages, a minimum age of the buildings and the mineral wool insulation was set to 20 years. Overall, the study includes results from 15 sampling points on seven objects from different European countries. The study included the application scope of facade insulation and flat roof insulation.

The age of the collected insulation samples ranged between 20 and 55 years. The results of the measurements demonstrated that the insulation materials were functional in all cases, despite their age, and especially showed excellent values of thermal conductivity.

Despite the satisfactory results, one may consider to extend the sample size of the study, as this may offer interesting possibilities of analysis by product type, application type, type of construction (rear ventilation, etc.), climate aspects, etc., which could give more detailed information on the factors influencing the durability.

Developing a robust measurement and evaluation method for determining the internal pressure of Vacuum Insulation Panels (VIP)

Max Engelhardt, Sebastian Treml

High-performance insulation materials have been a research area of FIW for many years, and more than ever vacuum insulation panels are an interesting example of this class. The European standardization has also picked up speed in this area, and a product standard is currently being developed by CEN in accordance with ISO.

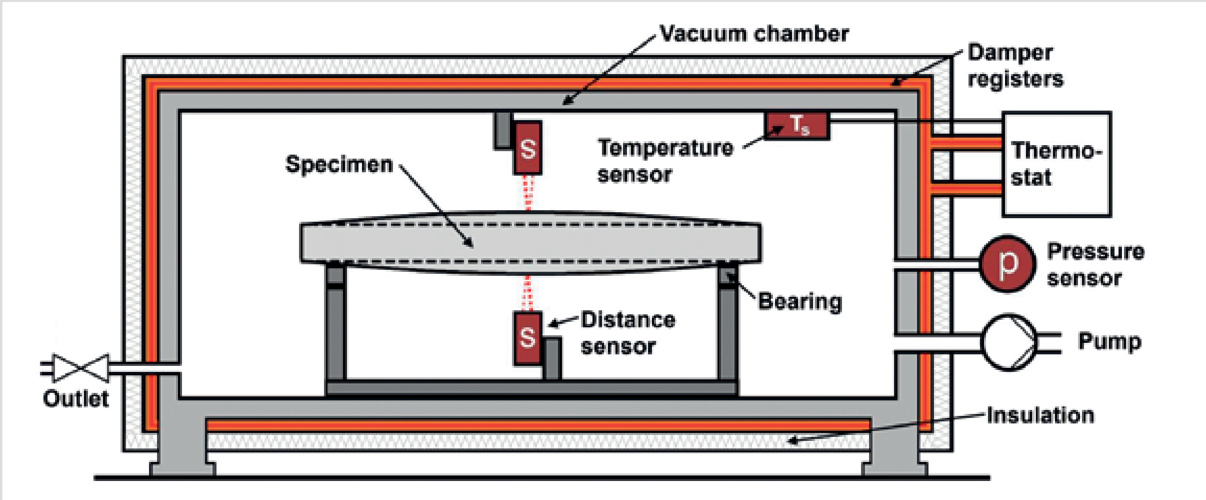
Especially against this background, issues related to durability and quality assurance are a pressing concern. For this purpose, it is necessary to establish a clearly defined and robust method to measure the internal pressure, because this measured variable is seen as a potentially quick and easy to determine procedure to provide information on the thermal conductivity of the samples indirectly. The lift-off method in a vacuum chamber is the most common method for determining the internal pressure. The chamber with the sample is evacuated until the pressure in the VIP is greater than the pressure in the vacuum chamber, and the film envelope lifts off from the support core of the VIP. This displacement is detected by laser triangulation. In parallel, the internal pressure of the chamber must be recorded in order to assign a pressure to the moment of time of the lift-off.

Currently, various parameters are being, such as
- Sample fixation or bearing,
- The number and position of laser measurements,
- Evacuation speed and direction,
- Temperature and its control,

in order to optimize the measuring process.

In addition to optimizing the measurement method, evaluation of the measured data to calculate a measurement result must be worked out, because it is an indirect measurement method. The development steps of the measurement and evaluation method are directly linked, and run in parallel and iteratively at present.

To date, there are no clearly defined and automated process descriptions of measurement data evaluation for the lift-off in the vacuum chamber. Since the foil lift-off method will be described as an internal pressure measuring method in the VIP product standard currently under development, it is important and urgent to develop and test the boundary conditions relevant to the measurement.



↑ *Schematic representation of the test setup for determination of internal pressure of VIP with the lift-off method in a vacuum chamber*

Cooperation project "Development of a measuring system for demonstrating energy savings through insulation measures"

Max Engelhardt

Already last year, we reported on the development of measuring stations for private home owners in our cooperation project with the company Karl Bachl Kunststofftechnik GmbH & Co. KG, which we have been running since 2014. The device is supposed to detect the real savings of heating energy demand, which are due to the energetic upgrade using the external insulation of the facade. Thus, the saving potential of the external insulation with ETICS, which is often implemented as part of a comprehensive renovation plan, can be demonstrated separately from the effects of the other measures.

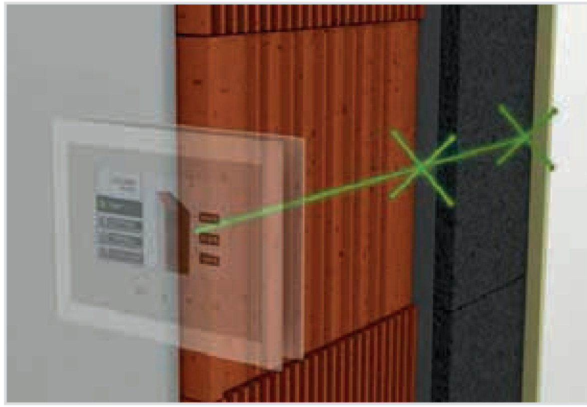
The measuring device is able to determine the U-value of the insulated construction, as well as the U-value of the original construction. The heat flows, which occurred in the uninsulated construction, can thus be subsequently calculated from the actual values (in the already insulated state). This makes the determination of the energy savings by the ETICS system possible.

The ETICS speedometer determines the savings on the basis of a calculation model, which involves multiple assumptions and simplifications, and is supported by an indirect measuring method for determining the heat flows. Therefore, extensive studies were necessary in order to optimize and to sufficiently determine the accuracy of the method and the hardware.

FIW supports the product development and the market launch from a scientific perspective, and provides information regarding structural and metrological issues. Data sets from simulation programs were generated, and Technagon was made available for the validation of the software. The scientific monitoring serves the objectives set out below:

- Demonstration of the software and hardware functionality
- Estimation of the device's measurement uncertainty
- Assessment of user-specific and structural influencing factors
- Clarification of structural and metrological issues before any market launch
- Ensuring the correct database for publications and marketing
- Production of a guide for installation engineers and users

The first prototypes have been manufactured and tested following a feasibility study that was carried out to deve-



↑ *The pilot production model. The microcomputer with graphical user interface is connected to an insulation plate of exterior insulation that is equipped with sensors. It contains sensors for determining the surface temperature of the outer wall.*

lop such a measuring device in a FIW research project in 2014. Requested was the reliability of the measurement concept as an affordable and user-friendly terminal device for private house and apartment owners, and invisible integration of measurement technology into the building shell as well as sufficient measurement accuracy.

The positive results of the study led to the continuation of the project. Now, field testing is carried out in renovated buildings with first successes, following extensive laboratory testing and software validations. Before the restoration of the buildings used to test the device, FIW determines the U-value of the exterior walls to be renovated by direct measurement on site. These are compared after the renovation with the values determined by the ETICS speedometer.

The collected data on the initial condition, the renovation, the display values, and the configuration data of the device and possibly consumption data and information provided by the users, then serve as a basis for the evaluation and assessment. Thus, the reliability, the accuracy of the calculation, and the practical use of hardware and software will be evaluated under real conditions with respect to the installation location, the characteristics of the building shell, and the user behaviour.

Annex 65 – Long-Term Performance of Super-Insulating Materials in Building Components & Systems

Christoph Sprengard, Christine Maderspacher

The “Energy in Buildings and Communities Programme (EBC)“ of the International Energy Agency, IEA, initiates wide-ranging research projects (annex) in the field of energy-efficient building.

The goal of Annex 65 is to increase use of high-performance thermal insulation materials and, as a consequence, to increase energy-efficiency in the building sector. This should be achieved by gathering, comparing and further developing existing know-how, and by testing and handling current products. In addition to this, clearly labelling hygrothermal attributes, as well as of their long-term behaviour should enhance the acceptability of these products.

In cooperation with different stakeholders from industry and research, principles of describing the characteristics, as well as test methods and procedures for standardized testing and evaluation of highly efficient insulation material should be applied. The results should be coordinated internationally, on a scientific basis. Ideally, they will be included in the normative area.

The tasks of FIW include, besides the management and coordination of the subproject on properties and measurement methods for high-performance thermal insulation materials, the analysis of reasonable aging methods.

Also essential is the development of appropriate testing and calculation methods of these high- end materials by analysing their area of application under boundary conditions.

A large round robin test was launched in September 2015 for this purpose. A total of seven different vacuum insulation panels (VIP) and advanced porous materials (APM) are tested in a total of 22 participating testing laboratories and research institutes. In addition to the measurement of thermal conductivity, also specific measurement of the thermal bridge effects at the panel edges, and the internal pressure of the VIPs are included in the scope of testing. In order to assess the long-term behaviour of the products, the tests are repeated after two aging steps. For the aging of the samples, storage at 50 °C and 70 % rel. humidity are applied for six months. This aging method corresponds to the draft of the CEN TC 88 WG 11 Task Group Ageing, which will be incorporated in the standardization. The same conditioning is also used for half of the APM samples. For comparison, the other half is conditioned with 80 °C and 60 % rel. humidity. FIW Munich is responsible for the complete coordination and evaluation of the round robin test.

A project meeting will take place every six months to communicate the current project progress and the first results. After the kick-off date in France, FIW organized the first working meeting in February 2015. The second meeting followed in September in Nanjing, China, which was held together with the international IVIS conference (International Vacuum Insulation Symposium).

Increase of energy efficiency through interior insulation systems – application scope, opportunities, and limits

FIW Munich and IBP Holzkirchen receive funding as research associations

Christoph Sprengard, Holger Simon, Christine Maderspacher

The reduction of heat requirements in existing buildings is an essential and economical measure towards meeting the energy-saving targets of the Federal Government. This can mainly be achieved by improving the thermal properties of the building envelope. Under certain circumstances, such as facades that need to be protected, or adjoining neighbouring buildings, proven measures like for example ETICS can’t be used. In these cases the aspired energy savings could alternatively be achieved by barely tested interior insulation systems.

Currently, the potential of interior insulation is far from being exploited because of the building physics risks, like mould growth or condensation, and the non-existing specific knowledge of the construction planners. To achieve the same savings with an interior insulation that you would get with an exterior insulation system, a thicker insulation layer is necessary, which leads to a further risk increase.

Given the above, a project to study hygrothermal properties of interior insulation systems was launched, in cooperation with the Fraunhofer Institute for Building Physics in Holzkirchen. During the three-years project period, a safe evaluation and assessment system of interior insulation constructions in terms of prolonged reduction of transmission heat losses is to be worked out.

Fundamental research work was carried out during the first 1.5 years of the project term. A detailed market research of the currently available internal insulation materials and systems was thus carried out. Furthermore, various partners from the industry could be gained for the research project. They support the project not only financially, but also provide their own insulation materials, from established EPS or foam glass systems through renewable materials like wood fibres and cork, up to innovative high-performance insulating materials for various tests.

The results and experiences from the research project “Increasing energy efficiency through interior insulation” should be available for construction planners and users and should provide a reliable validation of building physics risks of internal insulation systems. This should lead to an increasing application of interior insulation systems, and optimally exploit the energetic savings potential of the existing building stock.

Dew point monitor

Main processes covered by the quality management system in FIW Munich are testing and surveillance of insulation products , building materials and components, and certification of insulation materials according to the Construction Products Regulation and on the basis of voluntary certification programs. To guarantee the traceability of test results to the national and international standards, the in-house calibration laboratory carries out regular calibrations and inspections that ensure compliance with the required measurement accuracy.

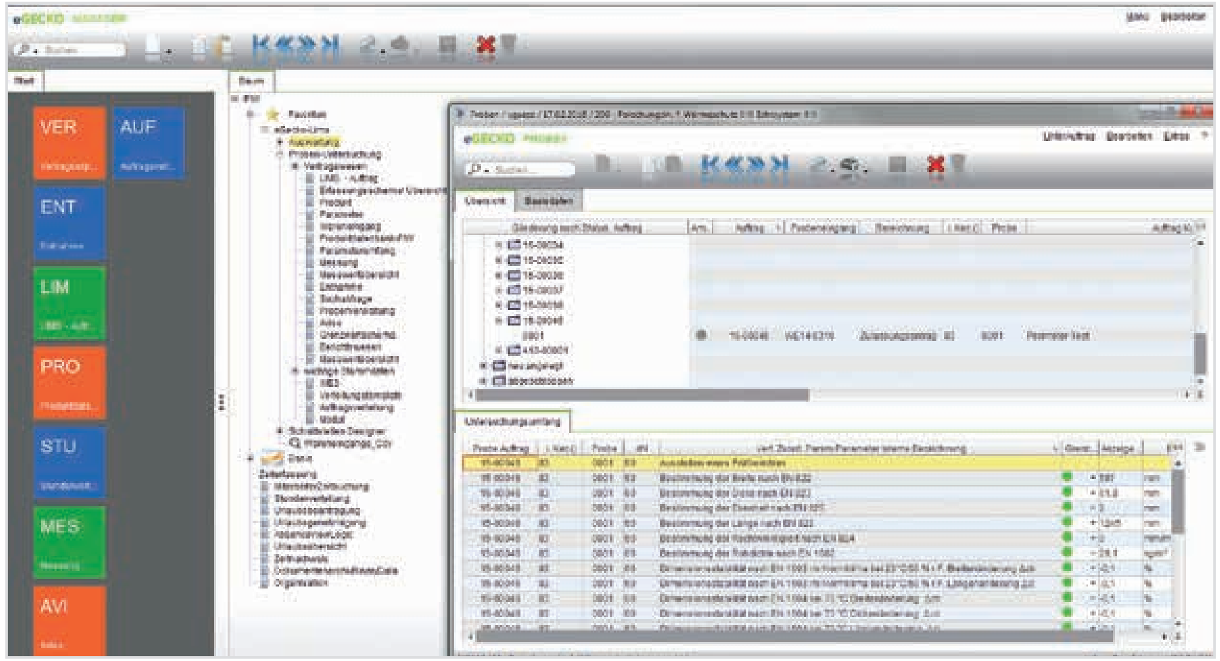
Practical calibration work using the example of the "moisture" parameter

In many processes, humidity is a key factor that requires monitoring. FIW Munich uses a chilled mirror hygrometer for internal humidity calibrations. This technology ensures the highest possible accuracy and reproducibility over a wide measuring range, and it is the first choice for calibration laboratories worldwide. A chilled mirror hygrometer measures the temperature at which a humid gas condensates on a surface. This directly measured dew point temperature is an indication of the absolute moisture content of the gas.

The commitment to continual improvement of the quality management system is met, for example in the field of measurement uncertainty, through continuous development of the test equipment, and investments in new calibration tools.

Successful implementation of a quality management system by FIW Munich has been certified by a third party through periodic audits of the German accreditation body DAkkS on the basis of DIN EN ISO/IEC 17025 for testing bodies, and DIN EN ISO/IEC 17065 for certification bodies.

This creates the basis for the recognition of FIW Munich as a European Notified Body in the field of insulating materials within the scope of the Construction Products Regulation.



eGecko

Implementation of ERP and LIMS software

Last year, we reported on the background to the introduction of a new "all-in-one software", and its first implemented applications.

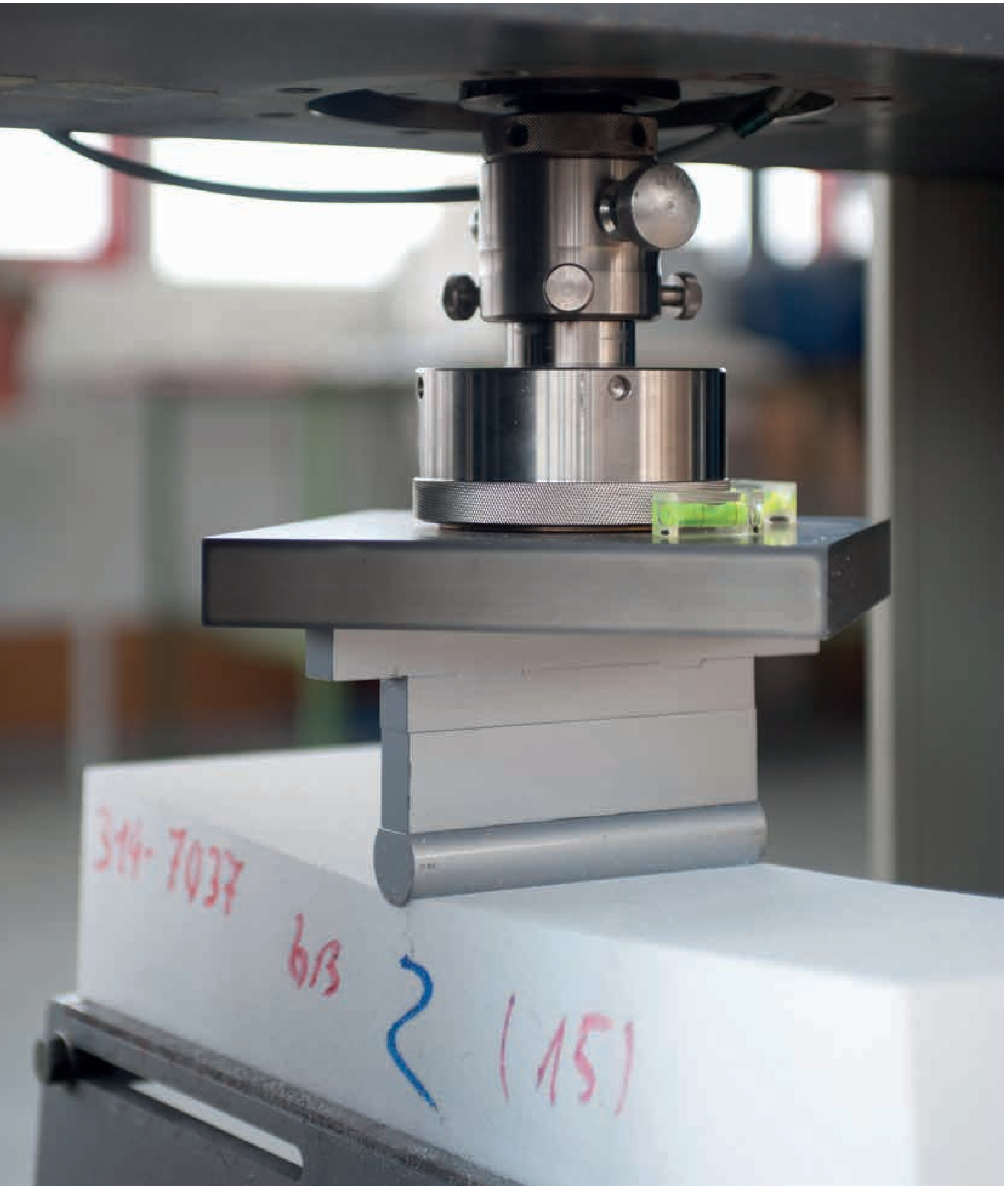
The new software is used across all departments of FIW Munich. In 2015, this software was used for time registration and leave approval, invoicing – this involved CRM (Customer Relationship Management) – and financial accounting/asset management.

Major update to software revision 31 was carried out at the end of 2015. This version integrates "FIW specific customization", such as e.g. "applicant/invoice recipient/goods recipient". This update has particularly affected the above-mentioned areas. In the earlier revisions, this was implemented by means of a user-specific customization. From our point of view, the step to revision 31 is also a step towards configurable standard software, which is the objective of the changeover.

Procedures have been refined in all areas. One example is contract management, which helps us to manage supplier contracts, and above all our own contracts with our customers. Contract management is also used to manage our members, which is a new feature.

The most important scope for FIW Munich is LIMS (Laboratory Information Management System), that is the area that concerns our tests and laboratories.

5 Testing Equipment and Devices



In the framework of the energy efficiency of buildings and industrial installations, material testing, certification, and quality control acquire increasing importance. In addition to our research and development work, we operate testing laboratories according to the highest quality standards. We have decades of experience and enjoy an excellent reputation. We have the latest examination possibilities as well as various analytical techniques. Given the increased demand for relevant studies, our testing laboratories are being continuously upgraded at a high level, both in terms of instruments used and in terms of staff. Currently, FIW Munich offers the following test equipment:

Testing equipment and devices for insulation materials in technical applications

Product Type Determination (PTD) according to EN 14303 – 14309, EN 14313, EN 14314

Thermal conductivity of insulation materials according to regulations of DIN EN 12664, DIN EN 12667, ISO 8301, ISO 8302, ASTM C 177, ASTM C 518, and the guidelines of DIBt, Berlin

- within a temperature range between -180 °C to 900 °C
- at 10 °C mean temperature
- at 40 °C mean temperature

Thermal conductivity of pipe insulations and pipe insulation systems according to test standards of DIN 52613 and EN ISO 8497

- within a temperature range between -70 °C and +300 °C mean temperature
- at 10° C mean temperature for cold insulation
- at 40° C mean temperature for thermal insulation of heating systems
- at 50° C mean temperature for district heating pipelines

Dimensional stability / Shape stability

- Dimensional stability under constant normal conditions according to EN 1603
- Dimensional stability under specified temperature and humidity conditions acc. to EN 1604

Behaviour at higher temperatures

- Maximum service temperature according to EN 14706 and EN 14707
- Maximum service temperature with and without oscillations

Measurement of the thermal transfer and the temperature field with standardized or individually designed testing devices on

- insulation systems
- components

Requirements of fire protection and fire resistance for construction materials

- Non-combustibility test according to EN ISO 1182
- Gross heat of combustion according to EN ISO 1716
- Ignitability of products subjected to direct impingement of flame according to EN ISO 11925-2

Mechanical properties

- Properties, dimensions, density according to EN 1602 and EN 13470
- Tensile strength perpendicular to faces according to EN 1607, pull-off resistance,
- Tensile strength parallel to faces according to EN 1608
- Deformation under specified compressive load and temperature conditions according to EN 1605
- Compression behaviour according to EN 826
- Shear behaviour according to EN 12090
- Bending behaviour according to EN 12089
- Behaviour under point load according to EN 12430
- Coefficient of thermal expansion according to EN 13471
- Compressive creep according to EN 1606

Hygric properties and behavior at freezing temperatures

- Long term water absorption by immersion according to EN 12087 Water absorption at temperature change 20 °C / 40 °C
- Long term water absorption by diffusion according to EN 12088

- Short term water absorption by partial immersion according to EN 1609
- Moisture content according to EN 322
- Water vapour transmission properties according to EN ISO 12572, EN 12086, EN 13469

Other characteristics

- Determination of the volume percentage of open cells and of closed cells according to ISO 4590
- Cell gas composition with a gas chromatograph
- Trace quantities of water soluble chloride ions and pH according to EN 13468
- Thermal stability
- Airflow resistanceaccording to EN 29053
- Non-fibrous component parts (shot content)
- Ignition loss according to EN 13820
- Filament diameter
- Determination of the abscence of silicone in thermal insulating materials

Acceptance measurements

- On-site measurements using heat flow meter and/or infrared camera

Test facilities for insulation material in construction

Product Type Determination (PTD) according to EN 13162–EN 13171

Approval tests for new insulation materials according to test plans of DIBt or European Technical Approval Guidelines (ETAG)

Testing of construction material class DIN 4102-B2 (normally inflammable)

Classifying of fire behaviour according to EN 13501-1, Class E and determination of ignitability according to EN ISO 11925-2

Measurement and testing of thermal conductivity of construction and thermal insulation products according to the standards EN 12664, EN 12667, EN 12939, ISO 8301, ISO 8302, ASTM C-177 and the guidelines of DIBt, Berlin

- in the temperature range of -30 °C to 80 °C mean temperature
- at 10 °C mean temperature

Mechanical properties

- Properties, measurements, thickness, density
- Thickness for floating floor insulating products;according to EN 12431 (compressibility)
- Tensile strength, bond strength, transverse tensile strength (EN 1607/1608)
- Compression test according to EN 826
- Shear behaviour;according to EN 12090
- Bending behaviour according to EN 12089
- Behaviour under point load according to EN 12430
- Dynamic stiffness according to DIN EN 29052-1
- Coefficient of thermal expansion according to EN 13471
- Settlement after vibration
- Settlement after climate testing 40 °C/90 % r. F.
- Determination of compressive creep according to EN 1606 up to a thickness of 300 mm
- Dowel pull-through strength according to ETAG 004

Hygric properties and behaviour at freezing temperatures

- Long term water absorption by immersion; according to EN 12087
- Water absorption at temperature change 20 °C/40 °C
- Long term water absorption by diffusion 50/1 °C according to EN 12088
- Freeze-thaw resistance and compression test according to EN 12091
- water vapour transmission properties according to EN ISO 12572, EN 12086, EN 13469
- Conditioning to moisture equilibrium under specified temperature and humidity conditions according to EN 12429
- Hygroscopic sorption properties according to EN ISO 12571 (DIN 52620)
- Short term water absorption by partial immersion according to EN 1609
- Moisture content according to EN 322

Dimensional stability/Shape stability

- Dimensional stability under constant normal laboratory conditions (23 °C/50 % relative humidity) according to EN 1603
- Dimensional stability under specified temperature and humidity conditions according to EN 1604
- Deformation under specified compressive load and temperature conditions according to EN 1605

Other characteristics

- Volume percentage of open cells and of closed cells according to ISO 4590
- Cell gas structure with a gas chromatograph
- Chloride content of HWL-panels according to EN 13168
- Airflow resistance according to EN 29053

Development of measurement and testing equipment

1. Development of measurement equipment

The FIW's measuring equipment is employed by customers in factory production control (FPC).

In 2015, the demand for heat flux measuring slabs (dimensions 500 mm x 500 mm x 8 mm and 200 mm x 200 mm x 8 mm) has risen; 10 pieces were delivered on time.

The following devices for determining thermal conductivity were developed:

- 4 devices (type GHP-750-250) for flat insulating materials up to a temperature of 700 °C on the hot side according to testing standards CEN TS 15548-1/ISO 8302/ASCM C 177/EN 12667.
- 2 devices (LHT-550-89) for determining thermal conductivity of moulded products at high temperatures up to 550 °C test temperature, according to the testing standard EN ISO 8497.
- A test bench (type LLT-120-ø) for medium temperature range up to 120 °C with three separately air-conditioned test chambers (-20 °C to +70 °C) and corresponding test tubes (22 mm, 28 mm and 35 mm).
- To determine the application limit temperature on flat insulating materials, a device (TYPE MSTP 800–300) according to the test standard EN 14706 was sold.

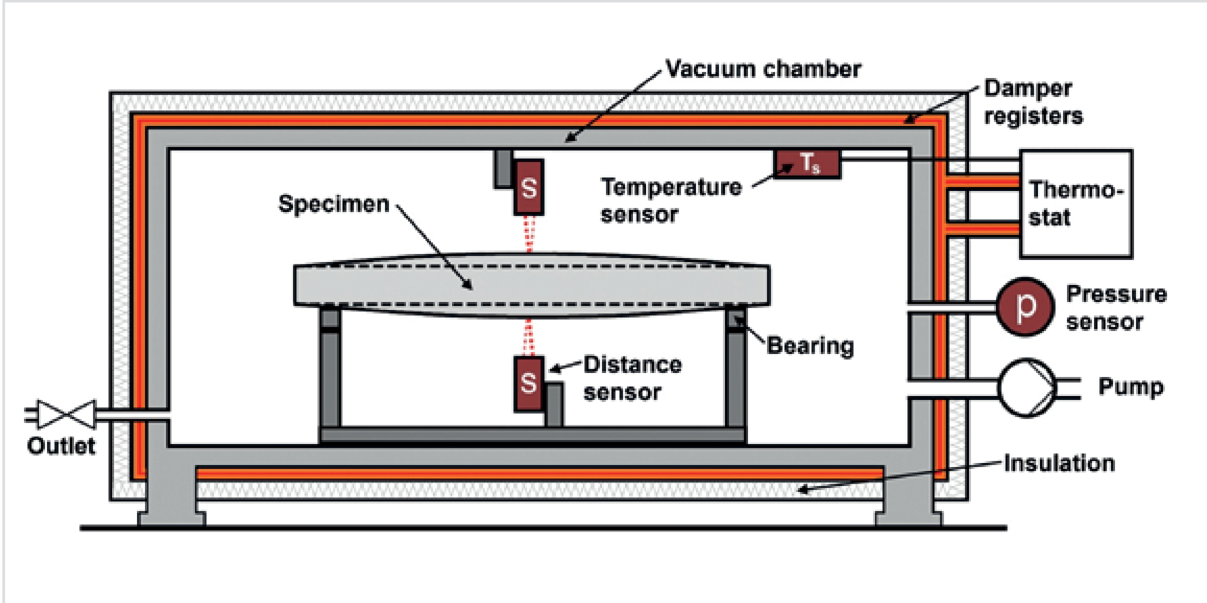
A secure website was set up in order to provide our customers with better service. It contains software updates, operating instructions, and also advice on testing implementation in German, English, French, and partially in Czech.
www.fiw-service.de

Contact person: Michael Guess

2. Fire alarm system

FIW Munich has decided to replace its fire alarm system with a modern system after 24 years of operation. The new system includes 355 automatic detectors, 28 manual call points, and about 6000 m additionally installed cables. The comprehensive system has been approved by the relevant district office and the Technical Inspection Authority [TÜV]. All group leaders were instructed about the localities during an on-site visit from the Gräfelfing volunteer fire department. About 70 members of emergency services were introduced to the building during two subsequent drills with the fire brigade.

Special testing equipment



↑ *Schematic representation of a variant of the test setup for determination of internal pressure of VIP with the lift-off in the vacuum chamber*

1. Vacuum chamber for testing the internal pressure of vacuum insulation panels (VIP)

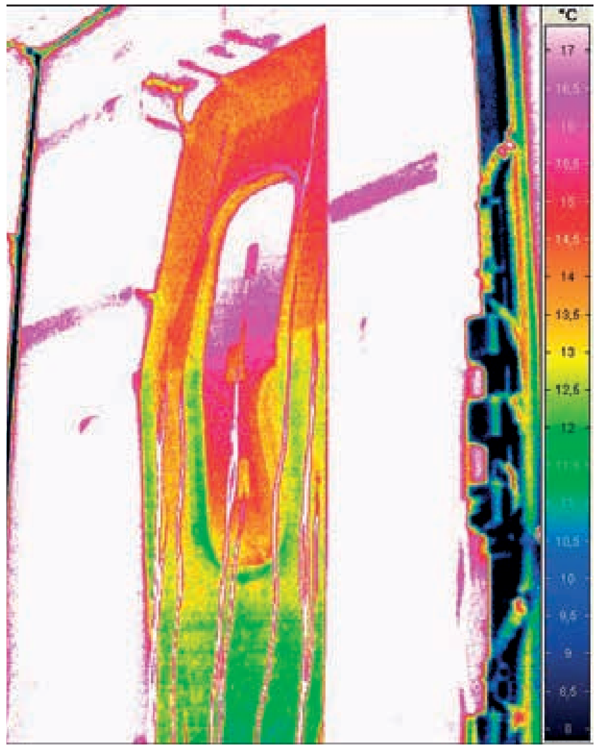
The internal pressure of vacuum insulation panels (VIP) is a measurement indicator that is potentially easy to determine, and that can directly provide information about the quality and, with limitations, also about the thermal conductivity of the samples. The foil lift-off method, where the ambient pressure in a vacuum chamber is lowered until it is equal to or lower than the internal pressure of the panel therein, is used as a method of measurement of the internal pressure of sealed panels. The foil of the panel lifts off, and the panel is inflated. The foil lift-off is measured by a laser distance meter.

FIW Munich put into operation a vacuum chamber for measuring the internal pressure of VIPs in 2015. An internal research project to determine framework conditions for the measurement, and to investigate the influences on the measurement results is currently being conducted as part of a joint research project with the Technical University Munich (see chapter 5). With the new device, FIW Munich fills a gap in the test methodology for determining the product quality of VIPs, and creates the opportunity to account for the internal pressure as another important parameter in the development of VIPs in future research. Thus, in the future also the causes of the thermal conductivity increases, the penetration of air and steam, will be examined in more detail, and their mode of action will be better understood.

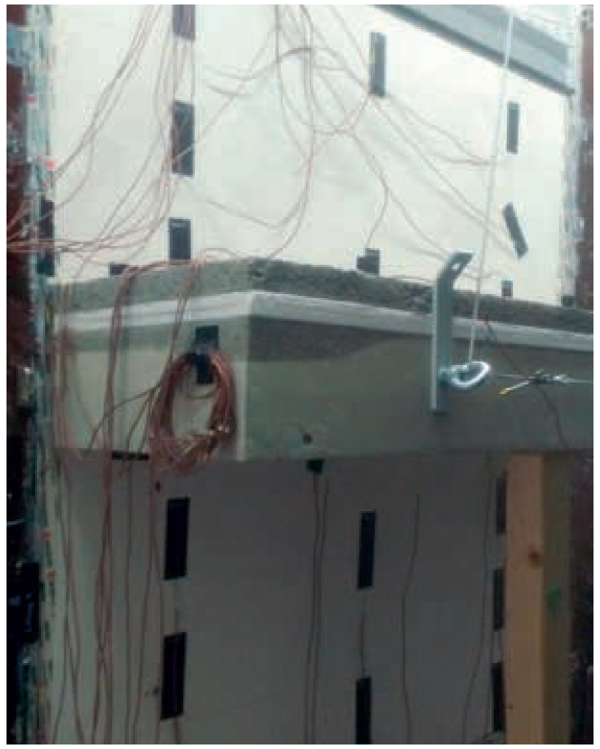
Contact person: Christoph Sprengard

2. A growing variety of test orders demonstrates the flexible possibilities for use of our differential air test stands with regulated heating box (hotbox method)

The U-value is used as a key parameter for the energy efficiency not only in the construction. The reduction of heat demand is playing an increasing role in the mobility sector. For example, several components in the field of automotive engineering, such as doors or folding and corrugated bellows, were characterized thermotechnically this year in our test stands. Differential air test stands are par-



False colour thermal image of a suburban train door leaf in the differential air test stand



Mounting an exterior wall construction with concrete ceiling in the test stand to investigate thermal bridge effects in interior insulation

ticularly useful to determine the thermal transfer coefficient of complex components. You can handle also difficult geometries, and you also have the possibility to consider standardized or custom framework conditions of temperature, humidity and convection. In addition to stationary measurements, targeted unsteady processes can also be measured, which can also be used for validation and optimization of calculation models. Also studies on thermal bridge effects, or analyses of drying behavior, e.g. in core insulation, are applications that can be successfully carried out using the hot-box method.

The realistic representation is a unique feature of this measuring method. FIW also has a rotatable differential air test stand, which allows measurements of test pieces in the horizontal or inclined position when installed. This ensures, e.g. when measuring the U-value of skylights, that the heat transfer through the adjacent moving air layers matches the real situation even closer, and the formation of convective rolls is taken into account.

Contact person: Max Engelhardt

3. Climate chamber for long-term conditioning of pipe insulation materials for cold water pipes

For metrological examination of pipe insulation materials when applied to cold water pipes in buildings, FIW provides long-term conditioning in a climate chamber. Insulation systems for this application have a high resistance to water vapour diffusion, in order to prevent a formation of condensate in the insulation system. The constructed insulation systems can be conditioned for several months after determining the thermal conductivity in an ambient

Climate chamber with newly integrated test piece at the start of measurement

temperature of 20 °C to 30 °C at relative humidities of 50 % to 90 %. A medium flows in a temperature range from 2 °C to 8 °C through the pipelines. The absorbed amounts of condensate are determined by means of regular weighing of the insulation system during the test.
At the end of the long-term conditioning, the thermal conductivity can be re-examined to determine if moisture storage led to an increased value. The test pieces are dried again following the test to determine the actual amount of water absorbed, and the distribution along the pipeline.

Contact persons: Roland Schreiner, Karin Wiesemeyer

New measuring and test equipment

Test facility for long-term creep behavior

1. Innovative, state of the art test stands for long-term creep behavior under compression according to EN 1606

The test facilities are used for long-term study of the deformation behavior of insulating materials under load. The usual test takes 1.67 years for an extrapolation time of 50 years. This property is important for the design of insulation materials in load-bearing applications.

Pending application applications and related test orders required a significant capacity expansion, which began already in late 2014 and was completed in 2015. The existing test capacity was thus increased by more than 50%. This allowed to carry out pending orders, and to create reserves in specific areas. Due to the increasing application of greater insulation thickness, the capacity was increased with specialised test equipment for samples of a greater thickness up to 300mm.

The testing equipment continuously detects the deformation with high-precision, automated distance sensors. The load is applied evenly and continuously through gravity and lever arms, and is thus independent of technical equipment. Due to the associated high deadweight of the equipment, a fully air-conditioned room with suitable structural equipment was created in the basement of the Institute for the new test stands.

Contact person: Stefan Sieber

2. Construction of a heat flow meter apparatus and optimization of measurement data acquisition in determining the thermal conductivity at low and medium temperatures in accordance with EN 12667

By the end of 2015, the self-made follow-up model for the heat flow meter apparatus No.13 to determine the thermal conductivity was completed. The new testing device has an airtight construction, which was achieved through optimized design of the interior insulation. The distance between the warm and cold side is measured by a magnetostrictive location sensor, which is connected to the warm side via quartz glass. Due to the low coefficient of thermal expansion of the quartz glass, the location sensor is not affected by the thermal expansion in the warm area, whereby the thickness of the test piece can be precisely determined even at higher test temperatures.

Another innovation in the thermal conductivity measurement is the change from central to local digital data acquisition. Until now, the measurement data of all testing equipment was retrieved at a central measuring station in the laboratory. The risk of a technical fault in the data acquisition corrupting all current measurements has now been eliminated by installing a measurement data acquisition unit locally on the testing device. This high-precision digital measurement technology was implemented by the end of 2015 in almost all 16 test devices for the determination of thermal conductivity.

Contact person: Anatoli Manski

3. Determination of dimensional stability under constant normal laboratory conditions according to EN 1603 – method B1

The 2013 version of EN 13163, the product standard for thermal insulation materials made of expanded polystyrene (EPS), restated the test method for the dimensional stability under normal laboratory conditions. In the past,

Heat flow meter apparatus according to EN 12667

it was sufficient to measure the EPS panels with a steel measuring tape in the delivery dimensions. Method B1, which uses the specimen size of 500mm x 500mm, poses higher accuracy requirements on the measuring equipment.

The process was adjusted in the past, and has now been complemented with a precision electronic height gauge to achieve the maximum accuracy in testing. The test pieces are stored in climatised room, which was built in 2014, in which the "European standard atmosphere" is ensured with a much higher consistency and precision than those required by the standard EN 1603.

Contact person: Stephan Guess

4. Testing facility for the determination of freeze-thaw cycling according to EN 12091 – modernization

Thermal insulation materials, which are exposed to moisture (inverted roof, perimeter insulation), are tested (after 300 cycles of one hour storage each at -20 °C and sub-water storage at +20 °C) with regard to change under compressive stress and water absorption. As a pretest, usually the

Freeze-thaw cycling

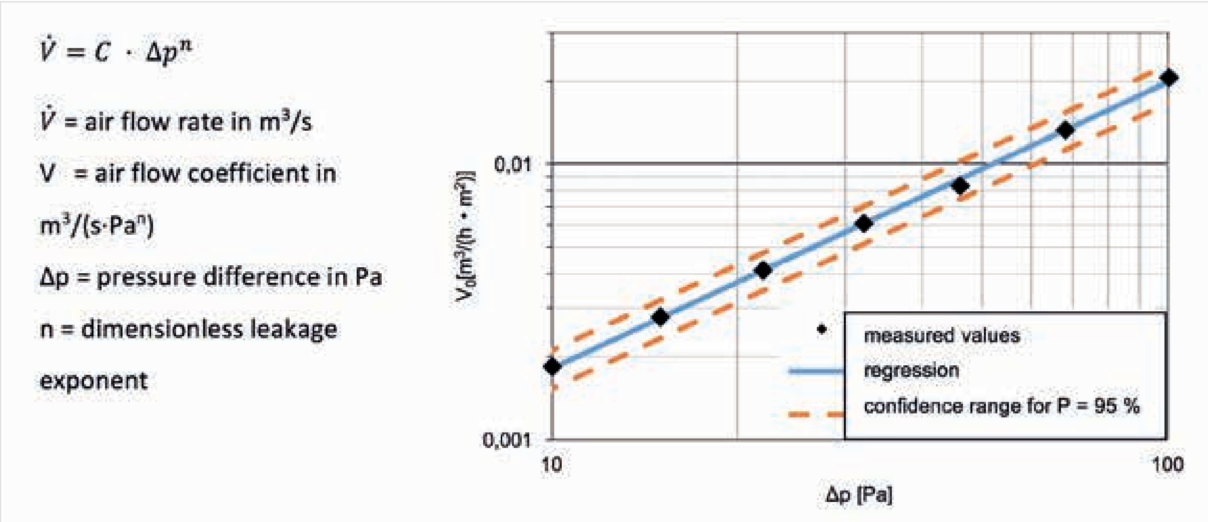
"Determination of water absorption through diffusion" according to EN 12088 is preceded to the freeze/thaw cycling test. The number of tests in this area has increased in recent years due to product development and the associated approval tests. In addition, the increasing thickness of insulation requires more testing room for the test specimens examined.

A decommissioned testing device has been modified and modernized by installation of a new control. The device was again used for tests end of 2015. Thus four machines will be available from 2016 to determine the behavior in freeze-thaw cycling, whereby the current process times will be shortened.

Contact person: Stefan Sieber

5. New test stand for the determination of air permeability of building components

The airtight design of the building shell is essential to meet the thermal requirements, and therefore the energy efficiency of the building. In addition to minimizing heat losses and optimizing comfort aspects, an uncontrolled airflow through building component also poses a risk of moisture damage when the steam that is carried along condensates within the construction. Conceptually, the airtight layer is distinguished in accordance with DIN 4108-7, and is



↑ *Determining the flow rate as a function of the pressure difference through regression of the measured values*

usually located on the warm side of the component, often installed in one functional unit with the steam barrier. In contrast, a wind seal is usually located on the cold side of the structure, and prevents e. g. entry of air currents into the insulating layer (e. g. underlays, rigid deck plates, etc.). In addition to the airtightness of the undisturbed building component surface, also the airtightness of complex components (e. g. roller shutters, windows, doors, etc.) is of course important, and must be assessed accordingly. Even if the quality of connection details is most important in this regard, the prerequisite for an air-tight building shell is, however, the provision of accordingly audited building and construction materials, as well as suitable components.

The determination of air permeability is carried out according to EN 12114 with a reference value at 50 Pa pressure difference. In the process, a series of pressure difference levels between 10–100 Pa is applied to the component or the construction material to be tested, and the flow rate required to maintain this pressure difference is measured. The relation of the flow rate is determined from the measured data as a function of the pressure difference by a regression method according to equation.

The leakage exponent indicates the flow characteristics within the tested cross-section, and is in theory between 0.5 (turbulent flow) and 1.0 (laminar flow, i. e. the flow rate, with the increase of the air volume flow coefficient, is then directly proportional to the pressure difference). A leakage exponent > 1.0 may occur when the air permeability increases with increasing pressure, e. g. due to structural changes.

FIW has been providing the option to determine the air permeability of building materials and components according to EN 12114 for a long time. To meet the requirements of the more and more airtight structures and building materials, the measuring range has now been significantly expanded, in particular in the area of low flow rates, by investing in new mass flow controllers. A measuring range of 0.012 ln/h–27000 ln/h, spread over only three sensors, is now available (ln = standard liter). The precision in the flow rate and pressure measurement, which is required by EN 12114, is maintained over the entire measurement range. Furthermore, the new sensors are now designed as part of a controlled system, with pressure reading as a control variable, which allows a high degree of automation of the measurement process.

Contact person: Dr.-Ing. Sebastian Treml

Voluntary certification system

Voluntary certification system for thermal insulation materials for use in thermal insulation composite systems (ETICS)

After the successful accreditation as a certification body for voluntary certification programs in accordance with EN 17065, FIW developed a “certification program for ETICS insulation materials“, which will replace the current voluntary surveillance of ETICS insulation materials. The certificates issued so far by FIW serve as a proof of quality for customers, and widely accepted in high regard by the supervision and certification bodies for the ETIC system, and by DIBt . Extensive insulation tests and audits due to the requirements of technical approvals for ETIC system suppliers were therefore not necessary .

The certification system asks for auditing of factory production control and the product sampling in the manufacturing plant twice-a-year, and the regular testing of all properties required by ETAG 004 and declared by the manufacturer.

Moreover, FIW offers an enhanced certification system Z-Plus. It ensures an even higher level of safety, and differs substantially from the (standard) certification program due to:

- Four test results for the thermal conductivity annually in order to perform a statistical evaluation (λ90/90). Four test results for tensile strength and dimensional stability at 70 °C as further main properties.
- Four factory inspections annually, of which two unannounced and two announced with an audit.
- Special testing of two batches in case of one negative routine test, with a reduced scope.

To ensure the acceptance of the test rules and certificates provided under the certification program in the certification of the ETIC system, the FIW's certification body was accredited for ETAG 004. The notification by the German Institute for Structural Engineering (DIBt) followed in October 2015.

Voluntary monitoring contracts for ETICS insulation made of expanded polystyrene (EPS)

Since 2012, FIW offers the voluntary external surveillance of these thermal insulation materials, issuing certificates on a yearly basis. As an interface between the insulation material and the ETIC system, these certificates serve as a proof of all properties and procedures required on European and the national authorities, as well as a proof of quality of the insulation products for the customer (ETICS manufacturer in this case).

These surveillance contracts with certificates have proved to be very practical, but they formally contradict the EUBauPVO and the accreditation of the FIW's certification body, and must therefore be discontinued by the end of 2016. Since December 2015, FIW has been providing an equivalent and extended (Z-plus) certification program for ETICS thermal insulation materials made of EPS, in which factory inspection, sampling, test scope, certificate creation, etc. are described in detail. The FIW's certification body has been accredited by DAkkS for the implementation of voluntary certification programs in accordance with EN 17067, as well as a certification body for ETICS systems according to ETAG 004. The notification by the German Institute for Structural Engineering (DIBt) followed in October 2015.

Voluntary certification programs are in principle an attractive alternative for the elimination of government-imposed external quality control. Manufacturers and customers can arrange them to demonstrate the compliance of declared properties, or to demonstrate high quality of a product or product group. Certification programs can be formulated with or without the quality mark acc. to EN 17030 (as a substitute for the Ü-mark).

FIW has decades of experience in testing, monitoring, and certification of thermal insulation materials, and it gladly incorporates this experience in the formulation of certification programs.

Certification programs can be extremely product- or application-related, whereby taking into consideration specific

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München

FIW München

ZERTIFIKAT *plus*

Nr.: FZ-xxx.0-01/16

zum freiwilligen, erweiterten Zertifizierungsprogramm (Z-Programm *plus*) des FIW München nach EN 17067

„Z-Programm *plus* für WDVS-Dämmstoffe aus expandiertem Polystyrol (EPS)“

zum Nachweis der Eignung für die Anwendung in Wärmedämm-Verbundsystemen (WDVS)

Produkt: **"Fassadendämmplatte EPS 032 WDV kd IR"**

Wärmedämmplatten aus expandiertem Polystyrol (EPS) nach DIN EN 13163
Blockware aus grauem Rohstoff mit IR-strahlungsabsorbierenden Eigenschaften mit Flammschutz Polymer FR
für die Anwendung in Wärmedämmverbundsystemen (WDVS) nach ETAG 004:2000
EPS-EN 13163-T(1)-L(2)-W(2)-S(2)-P(3)-BS100-DS(N)2-DS(70,-)2-TR100
Brandverhalten nach EN 13501-1: Klasse E

Der Hersteller **xxx-Dämmstoffe GmbH**, PLZ+Ort

hat mit dem **FIW München**, Forschungsinstitut für Wärmeschutz e.V., 82166 Gräfelfing
akkreditierte Zertifizierungsstelle nach ETAG 004 und EN 17065 für freiwillige Z-Programme

für das Herstellwerk **PLZ+Ort**

einen Vertrag über die freiwillige Zertifizierung des oben genannten Produktes geschlossen.

Die Zertifizierung umfasst die regelmäßige Überprüfung der werkseigenen Produktionskontrolle (WPK) auf Grundlage der EN 13163 und EN 13172 Abschnitt 5, sowie die regelmäßige Produktprüfung an zufällig im Herstellwerk entnommen Proben. Dadurch soll die Eignung des Wärmedämmstoffes für die Anwendung in Wärmedämmverbundsystemen nachgewiesen werden, die nach europäisch technischen Zulassungen (ETA) auf Grundlage der ETAG 004, sowie nach allgemeinen bauaufsichtlichen Zulassungen (abZ) geregelt ist, sowie ein freiwilliger Qualitätsnachweis für Kunden und Endverbraucher erbracht werden.

Folgende Eigenschaften wurden im abgeschlossenen Überwachungsjahr bei Produktprüfungen nachgewiesen:

Produkteigenschaften vom FIW München überwacht:	Fassadendämmplatte EPS 032 WDV kd IR	Jährlich erbrachte positive Nachweise
Wärmeleitfähigkeit (EN 12667): Nennwert λ_D:	0,032 W/(m·K)	4x pro Produkt
Messwert $\lambda_i \leq \lambda_D$ (Z-Programm plus Absch.6.6) oder $\lambda_{EN\ 13172\ Anh.\ F} \leq \lambda_D$ (λ_{Mean} aus 4 Messwerten) und $\lambda_{90/90} \leq \lambda_D$ in der WPK (EN 13163 Anh. A)	erfüllt	2x WPK-Kontrolle
Dicke (EN 823):	T(1) (± 1 mm)	4x pro Produkt
Zugfestigkeit senkrecht (EN 1607):	≥ 100 kPa	4x pro Produkt
Biegefestigkeit (EN 12089):	≥ 100 kPa	2x pro Produkt
Scherfestigkeit (60 mm Dicke) und	≥ 50 kPa	2x pro Produkt
Schermodul (EN 12090):	≥ 1000 kPa	2x pro Produkt
Wasseraufnahme bei kurzzeitigem, teilweisem Eintauchen (EN 1609):	≤ 0,2 kg/m²	1x pro Produkt
Wasserdampfdiffusions-widerstandszahl μ (EN12086):	≤ 70	1x pro Produkt
Dimensionsstabilität bei Normalklima 23°C/50%r.F. (EN 1603)	DS(N)2 (≤ 0,2 %)	2x pro Produktgruppe
70 °C über 48 h (EN 1604)	DS(70,-)2 (≤ 2 %)	4x pro Produkt
Länge und Breite (EN 822):	L(2), W(2) (± 2 mm)	je 2x pro Produktgruppe
Rechtwinkligkeit (EN 824):	S(2) (± 2 mm/m)	
Ebenheit (EN 825):	P(3) (3 mm)	
Rohdichte (EN 1602):	≤ 25 kg/m³	

Das Zertifikat ist gültig bis zum Datum.

Leiter der Zertifizierungsstelle

Gräfelfing, Datum

Dipl.-Ing. (FH) Wolfgang Albrecht

Dieses Zertifikat wurde nach positivem Abschluss des 1. Zertifizierungshalbjahres 2016 ausgestellt, ist 12 Monate gültig und wird nach positiven Produktprüfungen und Werksinspektionen im folgenden Zertifizierungshalbjahr erneuert.

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features such as change of thermal conductivity, influence of specific layers, etc. Furthermore, gaps in the European product standards may be filled:

The European standards for thermal insulation materials do not state how a single measured value of the thermal conductivity must be assessed. Although the product standards for the thermal insulation materials for buildings EN 13162 - 71 pose requirements concerning the statistical analysis of the thermal conductivity of the factory production control (λ90/90 ≤ λD), but they explicitly allow exceeding the nominal value of the thermal conductivity by individual measured values.

The European conformity standard for thermal insulation products EN 13172 proposes, in the informative Appendix F, a statistical method for assessing the thermal conductivity in the “case of complaint”, wherefore four test results are required. However, Appendix A of this standard, to which the certification of “Keymark” refers, provides only a one-time annual test of the thermal conductivity. The implementation of a certification requires transparent regulations that can be created in detail with certification programs.

With increasing elimination of mandatory external surveillance on basis of general technical approvals, voluntary certification programs can support manufacturers of thermal insulation materials in their product management through their declaration of performance (DoP) according to the EU Construction Products Regulation (CPR). With certificates from accredited certification bodies and test reports by accredited testing laboratories, the quality of thermal insulation materials can still be proven to customers.

Research and development options in the field of thermal insulation

Research
- Processing of research projects, concerning all fields of thermal and moisture protection of building components, facilities and buildings.
- Research on energy savings of buildings and on energy efficiency
- Applied research on insulation materials, building materials, and construction products
- Research on fundamental problems regarding heat and humidity, such as systematic screening of production parameters for thermal properties, or analysis of influence of humidity on thermal conductivity of building and insulating materials
- Application for subsidies for research projects, and project management of research contracts in Germany and Europe

Energy requirement of buildings
- Determination of energy consumption of systems or buildings
- Holistic approach to heat loss, taking into account location, climate, and user's consumption patterns
- Estimates of potential for renovations

Development of products and materials
- Optimization of hygric characteristics of insulation and building materials, and of construction parts and insulation systems
- Accompaniment of further developments of materials, products, components and building parts with calculation and simulation using modern computer programs
- Measurement of input data for thermotechnical simulations
- Determination of heat transition and moisture content of components and building parts on a scale of 1:1 up to a 3.5x3.5m component size
- A combination of numerical calculations, simulations, and laboratory testing for new building parts (such as vacuum insulation panels (VIP)), moisture-adaptive vapour barriers, low emissive coated insulation foils, or masonry blocks filled with insulation material), scientific support up to the market launch of the product
- Calculations, simulations an testing of hygrothermical characteristics for other sectors, for example cooling and freezing equipment, transport containers and cooling trucks
- Accompaniment of the complete value chain at a construction site, from raw material to construction component, and from construction component up to the complete insulation system – the building shell

Other research and simulations
- Calculations in a transient state, with rising or sinking temperatures
- Simulations for movement in liquids or gases (CFD)
- Measurements of building components or materials with a realistic moisture content to analyse moisture distribution in systems, and to better assess damages
- On-site investigations and monitoring of existing or newly constructed buildings
- Testing and simulation of long-lasting functionality of construction and restoration measures
- Surveys and assessments of potentials
- Catalogues of thermal bridges
- Support concerning technical manuals and product documents

National Committees and Boards

AGI (Arbeitsgemeinschaft Industriebau)

- AGI-Working documents Q-series
  R. Alberti

GSH (Güteschutzgemeinschaft Hartschaum e. V.)

- In-situ formed dispensed rigid polyurethane (PUR) (RAL-RG 710/7)
  R. Alberti
- GFA-PUR – Joint expert committee PUR roof spray foam and PUR spray foam
  S. Kutschera
- Working group Polystyrol (AAPS)
  S. Sieber
- Quality Committee
  S. Sieber
- Steering Committee
  S. Sieber

DIBt (Deutsches Institut für Bautechnik)

- SVA-A materials for thermal and sound insulation
  W. Albrecht
- SVA-B1 thermal conductivity
  W. Albrecht
- SVA-B3 thermal insulation outside the membrane
  W. Albrecht
- Ad hoc committee: Load-bearing thermal insulation of greater thickness under foundation slab
  W. Albrecht
- ABM colloquium of the fire testing laboratories
  W. Albrecht
- Experience exchange on thermal testing (EWM)
  W. Albrecht
- Experience exchange on testing, surveillance and certification bodies for, foam plastics and wood wool
  W. Albrecht
- Experience exchange on testing, surveillance and certification bodies for mineral wool
  W. Albrecht

Hauptverband der deutschen Bauindustrie (HDB) – Federal division for heat, cold, sound and fire insulation

- Technical committee (TA)
  R. Schreiner

IVH (Industrieverband Hartschaum e. V.)

- Expert committee (specification of monitoring processes, consultation on results and consultancy for the certification body)
  W. Albrecht
- WG External Thermal Insulation Composite (ETIC) System in IVH
  S. Sieber

IVPU (Industrieverband Polyurethan-Hartschaum e. V.)

- Technical committee of the Industrieverband Polyurethan-Hartschaum
  W. Albrecht

ÜGPU (Überwachungsgemeinschaft Polyurethan-Hartschaum e. V.)

- Expert committee (analysis of third-party monitoring results of ÜGPU)
  W. Albrecht

VDI (Verein Deutscher Ingenieure e. V.)

- Expert committee "Thermal insulation VDI 2055"
  R. Schreiner (chairman)
- Guidelines committee VDI 4610
  K. Wiesemeyer (chairlady)
- Expert committee "Energy use"
  K. Wiesemeyer
- VDI-Gesellschaft Energie und Umwelt (VDI-GEU), division 3
  R. Schreiner

Zentralverband des Deutschen Baugewerbes (ZDB)

- Association for the promotion of insulating technology: advisory and internet group
  R. Schreiner

DIN NABau (Deutsches Institut für Normung e. V.)

- NA 005-56 FBR "KOA 06 Energy savings and thermal insulation"
  Prof. A. Holm (chairman) (coordination committee)
- NA 005-56-10 AA "Insulation work on industrial systems in buildings and in the industry"
  R. Schreiner
- NA 005-56-20 GA "Energetic assessment of buildings" (DIN V 18599 among others).
  Prof. A. Holm
- NA 005-56-60 AA thermal insulating materials (SpA for CEN/TC 88, ISO/TC 163 and ISO/TC 61)
  Prof. A. Holm (chairman)
- NA 005-56-60 AA Thermal insulating materials
  W. Albrecht
- NA 005-56-60, Ad hoc 04 EPS
  S. Sieber
- NA 005-56-60 AA, Ad hoc 09 Wood wool
  S. Sieber
- NA 005-56-65 AA "Vacuum insulation panels (VIP)"
  C. Sprengard
- NA 005-56-69 AA "Thermal Insulation of Building equipment and industrial installation"
  R. Schreiner (chairman)
- NA 005-56-90 HA "Thermal insulation and energy savings in buildings" (SpA for CEN/TC 89 and ISO/TC 163) (standard series DIN 4108 among others)
  Prof. A. Holm (chairman)
- NA 005-56-92 AA Design values and requirements of heat transmission. Rated values of thermal conductivity (DIN V 4108-4) and minimum requirements for thermal insulation materials (DIN 4108-10)
  W. Albrecht
- NA 005-56-93 AA Airtightness (SpA ISO/TC 163/SC1/WG10)
  Dr.-Ing S. Treml
- NA 005-56-97 AA Transparent components (Sp ISO/ TC 163/ SC 1/ WG 14)
  C. Sprengard
- NA 005-56-98 AA Thermal insulation measurement
  W. Albrecht
- NA 005-56-99 AA Moisture (Sp CEN/TC 89/WG 10)
  Prof. A. Holm
- NA 005-02-09 AA Water proofing membranes (Sp CEN/TC 254)
  Dr.-Ing S. Treml
- NA 005-02-91 AA Underlays for discontinuous roofing and walls (Sp CEN/TC 254/WG 9)
  Dr.-Ing S. Treml
- NA 005-02-92 AA Rigid underlays for discontinuous roofing (Sp CEN/TC 128/ SC 9/WG 5)
  Dr.-Ing S. Treml

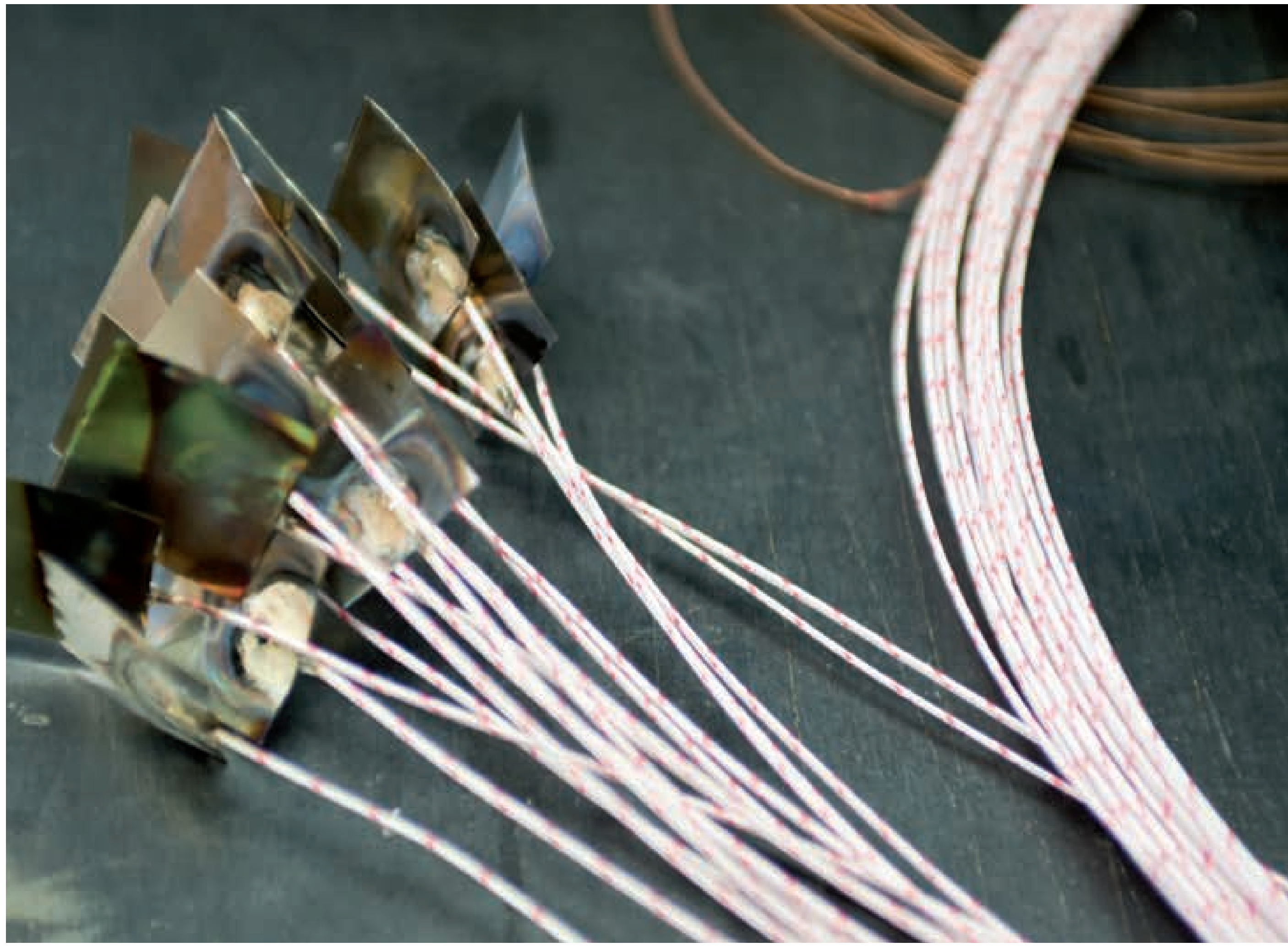
International Committees and Boards

ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers)

- TC 1.12 Moisture Management in Buildings
  Prof. A. Holm
- TC 4.4 Building Envelope Performance and Building Materials
  Prof. A. Holm
- SPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings
  Prof. A. Holm
- SPC 160 Criteria for Moisture control Design Analysis
  Prof. A. Holm

CEN (European Committee for Standardization)

- TC 88 Thermal Insulating Materials and Products
  Prof. A. Holm (Chairman)
- TC 88/WG 1 General test methods
  C. Karrer
- TC 88/WG 1 General test methods – ad hoc group ageing (accelerated ageing for XPS, PUR, PF)
  W. Albrecht
- TC 88/WG 4 Expanded Polystyrene Foam (EPS)
  S. Sieber
- TC 88/WG 4/Drafting Panel
  S. Sieber
- TC 88/WG 4/TG ETICS
  S. Sieber
- TC 88/WG 4/TG Test Methods and Test Result
  S. Sieber
- TC 88/WG 7 Phenolic Foam (Phenolharz-Hartschaum)
  W. Albrecht
- TC 88/WG8 Cellular Glass (CG)
  S. Sieber
- TC 88/WG 9 Wood wool (WW)
  S. Sieber
- TC 88/WG 10 Building equipment and industrial installation
  R. Schreiner (Convenor)
- Liaison officer with CENN/TC 166 Chimneys
  R. Schreiner
- TC 88/WG 10 Building equipment and industrial installation – Task group Test methods TGTM
  R. Schreiner (TG Leader)
- TC 88/WG 11 Vacuum-Insulation-Panels (VIP) for buildings
  C. Sprengard
- TC 88/WG 12 Expanded Perlite Boards
  W. Albrecht
- TC 88/WG 16 Evaluation of Conformity
  R. Schreiner
- TC 88/TG Liaison to TC 350/351
  R. Gellert (Convenor)
- TC 89 Thermal performance of buildings and building components.
  Prof. A. Holm
- TC 89/WG 3 Calculation of thermal insulation of equipment in buildings
- TC 89/WG 11 Thermal performance of buildings and building equipment – Task group 1
- TC 89/WG 12 Reflective Insulation Materials
- TC 254 Flexible sheets for waterproofing
  Dr.-Ing S. Treml
- TC 254/WG 9 Underlays for discontinuous roof coverings
  Dr.-Ing S. Treml (Convenor)
- TC 254/TG WG 9 and 10 Artificial Ageing
  Dr.-Ing S. Treml (Convenor)
- TC 371 Project Committee on Energy Performance of Buildings
- Notified Bodies-CPR / SG 19 Thermal Insulation Products
  W. Albrecht, R. Schreiner



CEN Certification

- SDG 5 Thermal Insulation Products TG λ - Expert Group (Establishing of a common measuring level of thermal conductivity in Europe)
  W. Albrecht
- EUMEPS (European Manufacturers of Expanded Polystyrene)
  S. Sieber

ISO (International Organization for Standardization)

- TC 163 Thermal performance and energy use in the built environment SC1
  Prof. A. Holm (Chairman)
- TC 163/WG 5 Vacuum-Isolation-Panels (VIP)
  C. Sprengard

EUMEPS (European Manufacturers of Expanded Polystyrene)

- Technical Working Group
  S. Sieber

QAC (Quality Assurance Committee)

- VDI-Keymark scheme for thermal insulation products for building equipment and industrial installations, the voluntary product certification scheme
  R. Schreiner (Chairman)
- Laboratory group
  R. Schreiner

"Is the energy revolution on target?"

About 150 participants from business, industry and politics accepted the invitation by the Forschungsinstitut für Wärmeschutz e.V. München (FIW München) for this year's Thermal Insulation Day in the Haus der Bayerischen Wirtschaft in Munich, under the heading "Is the energy revolution on target?" Besides the welcoming speeches and specialist presentations, the main focus of FIW-members, industry insiders and guests was on mutual consultation.

In his keynote, FIW's chairman, Klaus-W. Körner, outlined the current energy efficiency situation: "The black-yellow government has defined the energy efficiency as the second pillar of a sustainable energy transition as early as 2010 in their adopted energy concept. The requirement was then that reducing energy consumption through energy efficiency should be regarded as the foremost component of the energy revolution. Today, all of us here must realize that this requirement has not been sufficiently taken into account. FIW Munich welcome all the more the fact that the Grand Coalition has introduced – in the action programme for climate protection and in the National Energy Efficiency Action Plan (NAPE) at the end of 2014 – its plans and strategies for meeting the energy efficiency targets. The building sector, which is responsible for 40 % of energy consumption in Germany and Europe and for 30 % of emissions, is clearly at the center of the programs. Energy efficiency in the building sector is a cornerstone of NAPE and must remain so, since about half of the 19 million buildings with about 40 million flats is due to be renovated in the next 20 years. This affects not only residential buildings, but also non-residential and public buildings. From FIW's point of view, another objective of the Merkel government, which is to achieve a virtually carbon-neutral building stock by the year 2050, is at least equally important. The primary energy consumption should be reduced by 80 % compared to the year 2008". Klaus-W. Körner stressed that the energy efficiency of buildings, is also a very social obligation. Körner called on the politicians to create a balanced mix of requirements, incentives and information, which would allow the building owners a cost-based and targeted implementation that is open to new technologies. According to Körner, all that must lead to an energy-economic overall concept, which must be implemented by the politicians.

dena (Deutsche Energie-Agentur GmbH) has been the co-organizer and partner of the Thermal Insulation Day. Ulrich Benterbusch, chairman of its executive management, spoke on behalf of dena. His presentation was under the heading of "What is the future of the energy revolution? Current challenges and opportunities". Benterbusch talked about the failed fiscal promotion, and proposed a new federal "incentive program for energy efficiency" with a total of 165 million euros. This should cover investment grants for fuel cell heating, efficient heating techniques, combinations of measures for energy efficiency and housing value appreciation. Comprehensive quality, consulting and education campaigns accompany the measures. The head of dena also reported on the success of the pilot project for efficient houses that is a model of low energy consumption and high level of comfort nationwide. More than 400 buildings, including schools, sports centres, museums, single-family houses, and apartment blocks have participated. According to Benterbusch, the average energy savings amounted to almost 80 %. According to a survey conducted among the participants, 86 % would again decide in favour of the selected energy standard, 12 % would implement a higher standard, 97 % would never like to live in a non-renovated building, and 98 % recommend an energetic renovation to their friends.

The State Secretary Franz Josef Pschierer, Member of the State Parliament from the Bavarian Ministry of Economic Affairs and Media, Energy and Technology, gave the welcoming speech on behalf of the Bavarian government. Pschierer thanked FIW Munich in a very personal way, but also on behalf of the entire Bavarian government for organizing the Thermal Insulation Day, and for its key pioneering research for the past 97 years. The Secretary of State cited a simple wisdom "Every kilowatt hour that we do not consume does not need to be created, nor transported". And according to Pschierer this not only applies to electricity, but also and especially to heat. Pschierer sees the greatest potential in energy efficiency in buildings, because many apartments were built in the times when the energy was cheaper. "At that time, almost no one thought about insulation. That's different now. The utility costs are only rising", said the CSU Member of Parliament. Pschierer commented on that: "Not enough energetic renovations are carried out. The renovation rate of buildings is currently only 1 %. The Bavarian state government wants to use this enormous

potential in the building sector, and to reduce the energy consumption of buildings by 20 % by 2021. This requires a broad incentive system. Bavaria adheres to the fiscal promotion of the energetic building renovation, and it does so without sacrificing the craftsman bonus". However, since the Land of Bavaria does not want to wait for the federal government, the Secretary of State informed about the upcoming launch of the 10,000 houses program. "The Bavarian government will itself set powerful accents and promote the intelligent interaction of heat and electricity, saving, load management and networking. We are investing 90 million euros for this purpose", said Pschierer.

A highlight of the 2015 Thermal Insulation Day was the presentation of the Spiegel editor and author Jan Fleischhauer, who presented a report under the heading "Energy efficiency and the press - how media judgments are formed". Fleischhauer talked about the inner workings of the Spiegel redaction in an entertaining, pointed, and partly ironic manner. In December 2014, the editorial board was only able to make a decision on the title, "The Nation is Dumped", which run over eight pages, after FAZ and Frontal 21 - "the Champions League of the German press" - printed reports on the "insulation madness". Fleischhauer tried to inspire hope and to reassure those present: You are certainly not "Damped or damned to all eternity", as the Spiegel headline suggested. The situation of the food industry, for example, is much more difficult than yours. You are lucky because you do not have powerful enemies, and therefore your environment will calm down, where it has not done so already". Using some press clippings, the Spiegel editor demonstrated, in part criticizing his own profession, how some media repeatedly and deliberately feed the readers with prejudices that cannot be proven.

Specialist presentations were given by Müller-Kraenner, the national director of the German Environmental Aid (DUH), among others. His topic was "Targeted communication for a successful energy revolution - what is the role of environmental organizations?" Dr. Alexander Renner from the Federal Ministry for Economic Affairs and Energy presented the National Energy Efficiency Action Plan

(NAPE) in detail. Marita Klempnow, the spokesperson of the Management Board of the German Energy Consultants Network (DEN), presented a report under the heading "Neutrality and quality assurance - the challenge of the energy consulting", and Frank Junker, Chief Executive of AGB Frankfurt Holding, spoke on "There is no way around insulation - from passive house to active house". Other speeches were made by Stephan Kohler, the spokesman for geea (Alliance for Building Energy Efficiency), and Günther Hoffmann, the Undersecretary at the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.

Prof. Dr.-Ing. Andreas Holm, the Managing Director of FIW Munich, summarized the Thermal Insulation Day 2015 in a final speech. Holm concluded that different presentations of the event would have clearly indicated that the question of whether the energy revolution was on target could not be answered with a clear "yes" or "no". More efforts were needed, mostly on the part of the politics, to make the energy revolution a success, according to Holm. "The Thermal Insulation Day of FIW Munich has hopefully offered the necessary food for thought and stimulus in this regard," concluded the Managing Director, and thanked all contributors most sincerely for their commitment.

Most of the presentations of the Thermal Insulation Day 2015 can be downloaded free of charge under www. waermeschutztag.de.

For further information, please refer to:
www.waermeschutztag.de

Research afternoon at FIW Munich

The FIW's employees presented the latest results on 20 May 2015. The variety of topics ranges from basic research to the heat transmission in piles, through the efficiency of heat-insulating measures, the recyclability of insulation systems, up to ensuring the quality of insulation. Based on the research activities, it will be possible to optimize the entire life cycle of insulation materials in the future.

Efficiency of thermal insulation methods

Prof. Dr.-Ing. Andreas Holm

The building owner is ultimately responsible for the renovation of buildings, and therefore for the implementation of the renovation rates required by the federal government. It must decide when and to what extent the repairs or energy upgrading will be carried out. The economic viability of insulating the building shell has been repeatedly questioned in the increasingly negative media reports.

Repair measures, apart from any energy improvement, cost money. Costs are an obstacle to an energetic renovation if the owners or investors lack the financial means to implement the measures, or when those measures do not seem sensible. An important question in all energy-saving measures is whether can the additional costs incurred with construction or renovation can be compensated through lower heating costs during the period of use of a building.

In addition to the climatic, structural, geometrical, and economic parameters, the results are also influenced by the chosen calculation method itself. The causes heated public discussions about the purpose of such measures.

As a general rule: The nature, scope and implementation of renovation measures must be tailored to the building, and therefore require a competent custom analysis by a qualified energy efficiency expert, who can create, via a thorough inventory, a renovation roadmap that describes the order in which the measures should be sensibly implemented, and which potential savings can be thus achieved. In any case, insulation measures on the building shell are especially worthwhile for example when repairs to the roof are due anyway, or when the plaster of a facade is due to be replaced. When energy improvement measures are thus integrated into an overall modernization, costs for scaffolding, building site setup, construction

waste troughs, etc. are only due once, thereby reducing the cost of the actual energetic renovation.

This means that statements on the efficiency and usefulness of an energetic renovation measure are sensible only when the building is considered individually and as a whole. All profitability calculations conducted from an economic point of view must be based on the correct reference. It is necessary to differentiate between a partial and a total cost.

Moreover, for the evaluation of the efficiency of an insulation measure, it is necessary to specify multiple parameters, such as for example the energy price that was used as the basis and its future development, climatic framework conditions, user behaviour, or the development of financial markets. However, this data is not always known, or in case of energy price changes the values can only be assumed. Therefore, statements on the efficiency of various renovation measures, which are made nowadays by industrial circles, housing industry, house owners, but also by scientists, may vary considerably. Depending on the calculation approach, different conclusions about the payback of an energy-saving measure can be reached. The impact on the amortization period, taking into account all relevant parameters and their range, can be determined using a "Monte Carlo simulation". It allows to calculate the amortization period of the full costs invested with no less than 95 % probability; obvious outliers are nearly ruled out.

Possibilities of recycling components from external thermal insulation systems, and of returning them to the production cycle or respectively downcycling in the production of raw materials up to thermal application

Wolfgang Albrecht

Background and definition of objectives

Considering that many ETICS from the seventies are in line for a revision, FIW conducted a study, together with its scientific project partner, Fraunhofer-Institut für Bauphysik, Holzkirchen (IBP), which was meant to analyse the following issues::

- What happens to the components following the use phase,
- If they can be sent for further recycling,
- Dismantling,
- Recycling options,
- Forecast of the future amount of waste.

The research project has been sponsored by the Federal Institute for Building, Urban Affairs and Space Planning, and was accompanied with financial and expert support by the Fachverband WDVS and Rigid Foam Industrial Association (Industrieverband Hartschaum e. V. IVH).

Waste quantity

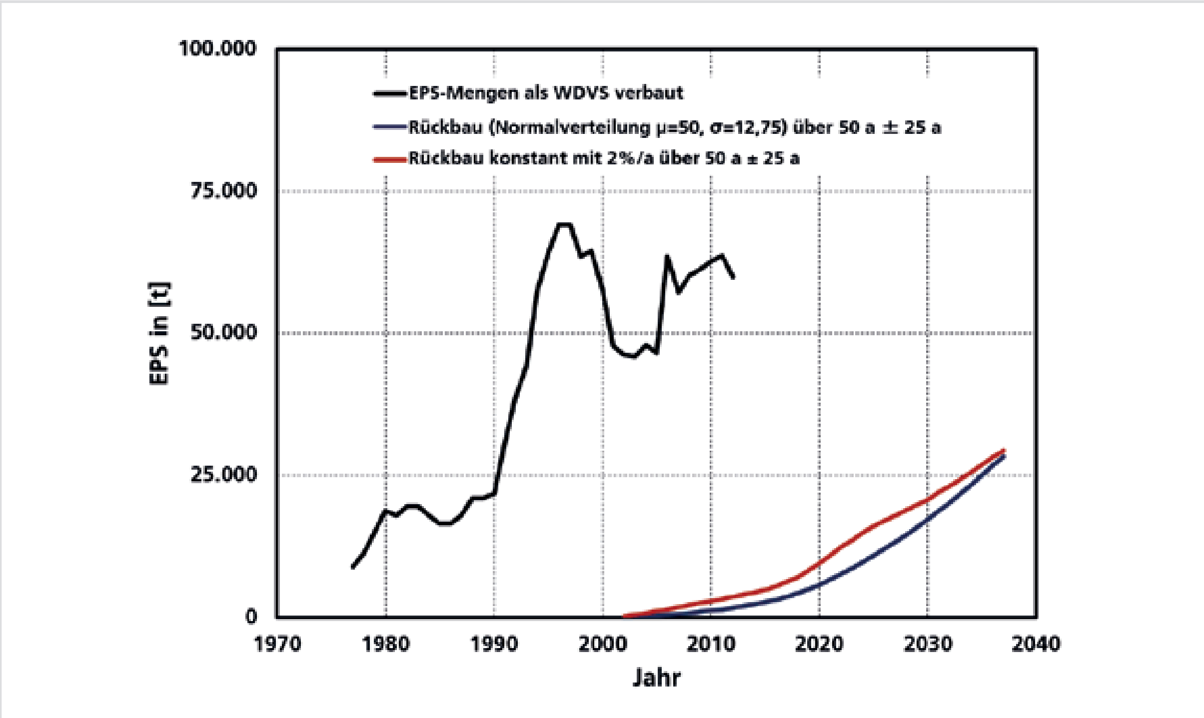
According to the Fachverband WDVS, from 1960 until 2012, 900,000,000 m² of ETICS were installed in Germany. Nearly 720,000,000 m² (80 %) were EPS systems. Depending on thickness of the EPS layer, this results in a total mass between 646 und 1570 kt. Added to this are further

installed ETICS components like 2822 kt adhesive, 2880 kt basecoat mortar, 130 kt fabric, 2160 kt top coating, and nearly 2.6 billion dowels.

Regarding the amount of waste, there was a total amount of 4,400 kt of plastic waste in 2011 in Germany. The share of EPS and XPS (not only ETICS) from the construction sector was 42 kt pa, which means less than 1 % of the amount of plastic waste.

Dismantling and retrofitting

From the current dismantling methods, four options have been looked into closely. Nowadays, mainly the manual decoating with a scraper and mechanical decoating with excavators are being used. Thermal decoating and milling play a subordinate role in practice. The current methods for demolition of buildings using heavy machinery facilitate and accelerate the operations. However, in conventional demolitions the different fractions are mixed, so that additional effort is needed for the separation and recovery of recyclable materials. The manual stripping or the selective demolition, although labour-intensive, allows the separation of the different fractions. The various methods were examined and tested in more detail.



↑ *EPS sales volumes for ETICS, and forecast for the decommissioning*
Source: FV WDVS and IBP Holzkirchen

When after 30-50 years the ETICS needs retrofitting, such as a new plaster layer, or doesn't correspond to the current technical state of the art, these systems are not dismantled but doubled, newly dowelled, and plastered. These measures significantly prolong the service life of an ETICS, and can spread it from 40 up to 120 years, according to current estimations.

Recovery of EPS-Waste
Three options to recycle EPS waste from ETICS can be used at the moment. EPS-recycling boards with a recycling rate up to 100 % are an example for material recycling. Because of the HBCD interdiction, this waste disposal will not be possible in the coming years. It will be available only for HBCS-free EPS construction and production waste. The CreaSolv® process for a "selective extraction" of polystyrene, with the help of organic solvents, is an example of raw material recycling advantages. The main advantage of this process is the separation of flame retardant HBCD and other pollutions. This makes it possible to produce polystyrene with the characteristics of new polystyrene. However, this process is not being used commercially at the moment. A larger test plant is scheduled to start operation in approx. 2 years.

This gives thermal recycling of EPS, that has served its time, a very important role. For this, the waste-to-energy plants, distributed throughout Germany, can be used. They are on a very high level. The advantage of this process is that parts of the energy, used during the production, can be recovered when the material is being burned. A large-scale test in the waste-to-energy plant in Würzburg has proved that, for technical reasons, a maximum of 2 % EPS or XPS should be added to the residual waste. The measured contaminant concentration remains significantly under the permitted limits.

In the future, the new waste code for insulation materials containing HBCD, after they have been added to the so-called POP list, could complicate the thermal recycling

of EPS waste with the old flame retardant HBCD. They are supposed to be identified as hazardous waste in the future. Meanwhile, several waste-fuelled power stations are authorised to continue to burn waste containing HBCD. More waste-fuelled power stations will follow.

Forecasts and conclusions
The consensus of disposal companies and associations, but also the conclusion drawn from waste statistics is that the current quantity of waste is still at a very low level because of considerably longer lifetime, contrary to earlier assumptions. Still, the dismantling volume will increase considerably in the next decades. Using a newly developed forecasting model, the amount of EPS waste from ETICS has been estimated to grow until 2050, and is expected to reach a volume of waste of 50 kt pa. This corresponds roughly to the expected annual production of EPS for ETICS, and can easily be handled with the existing capacities of waste-to-energy plants. This makes the energetic utilisation ecologically and economically an appropriate recycling method for the next 10 to 20 years.

As the energetic recovery of existing ETICS through doubling can only delay but not prevent the dismantling process, the authors of the study recommend positive labelling of HBCD-free EPS, and developing rapid tests for the reliable application on construction sites and in disposal.

Just as useful is the development of advanced techniques, machines, and tools for a selective deconstruction of single-layered or doubled ETICS. Alternative joining techniques could also simplify dismantling. In the medium term, recycling procedures for raw material, like selective extraction, should be further developed to save EPS raw material and protect natural resources in the long-term on a commercial scale.

In summary, the future focus of research and development will be on the areas of mounting technology, double layers and demolition, labelling, detection and analysis of HBCD, and the further development of recycling processes.

Surveillance of thermal insulation products yesterday, today, and tomorrow
Claus Karrer

Supervision of insulating materials has a long tradition in Germany. Besides the research on physical fundamentals of measurement methods for the determination of thermo-technical variables, also their consistent and regular application by a neutral and competent body was a main motivation for the industry to establish FIW Munich in 1918. Supervision of thermal insulation products was established in 1938 with the introduction of the first German industrial standard for thermal insulation materials, DIN 1101 for wood wool lightweight plates. The standardization of the "new" thermal insulation products made of mineral wool (DIN 18165 of 1957) and rigid insulating foams (DIN 18164 of 1963 for EPS, XPS and PUR) followed. Thanks to that, a high level of quality of thermal insulation products could be achieved in Germany for decades, which was unusual in Europe. That also led to fair market conditions for manufacturers. With the introduction of the European product standards for thermal insulation materials in 2003, these DIN standards were withdrawn and replaced by the corresponding regulations.

Today, FIW Munich carries out external inspections of thermal insulation materials based on the following:

1. European guidelines, namely European product standards for thermal insulation materials (EN) or European technical approvals (ETA). These provide the conformity system 3 for thermal insulation materials, which means almost exclusive producer responsibility without any monitoring by a neutral body. The manufacturer labels its product independently with the CE mark based on its declaration of performance. Only thermal insulation materials with reaction to fire class A1, A2, B and C require a certification with continuous monitoring, assessment, and evaluation of factory production control, but only for the property of reaction to fire - not for thermal or mechanical properties.

2. National, German guidelines, usually general building approvals (abZ) that require a third-party inspection and certification of insulating materials.

2.1. General technical approvals for European standardized insulation materials (Z-23.15-xxxx), which govern specification of the design value of the thermal conductivity based on a limit value (DIN 4108-4 Category II), combined with a voluntary supervision and testing of all properties required by the application standard DIN 4108-10: In line with the general interpretation of the judgment C-100/13 of the ECJ of 16.10.2014, these general building approvals are regarded as an inacceptable "readjustment" of European standardized construction products, and may no longer be bindingly required by the German legislation after the ECJ verdict has been implemented. The statement of the German authoritiy “Deutsches Institut für Bautechnik” (DIBt) announced a modification of DIN 4108-4, which is already present as a draft. On the other hand, DIBt announced extensions and re-issuing of approvals Z-23.15-xxxx until 15.10.2016 (2-year period to implement the ECJ judgment) with a maximum applicability period until 2020, provided that the corresponding applications are filed until 31.01.2016. On this basis, the manufacturers could implement external monitoring on a voluntary basis after implementation of the ECJ Judgment, with further optional use of these approvals (as of February 2016). This also applies to thermal insulation materials for external thermal insulation composite systems (ETICS), which are regulated by technical approvals Z-33.4-xxxx, provided that those are governed by a European product standard. Insulating materials that are not standardized in Europe, and therefore do not carry a CE mark, are not affected. For those materials, approvals for this application can still be issued which provide for binding supervision.

2.2. Technical approvals for the application of thermal insulation materials or for insulation systems (Z-23.34-xxxx for thermal insulation materials under load-bearing floor panels, Z-23.31-xxx for inverted roofs, Z-23.33-xxxx for perimeter insulation): these approvals also regulate the application or the insulation system, and are not subject to the ECJ judgment according to DIBt. However, this will be established only following the implementation of the judgment C-100/13 of the ECJ by a modified pattern or by introduced state building regulations. The binding status of the supervision required by those approvals depends on those new regulations (as of February 2016).

2.3. General building approvals for insulation materials without European basis (e.g. Z-23.11-xxx.): Those materials are not affected by the ECJ ruling, and will still be granted by DIBt, including the usual arrangements for supervision.

Modelling of heat transport in piles in the extended temperature range
Robert Hofmockel

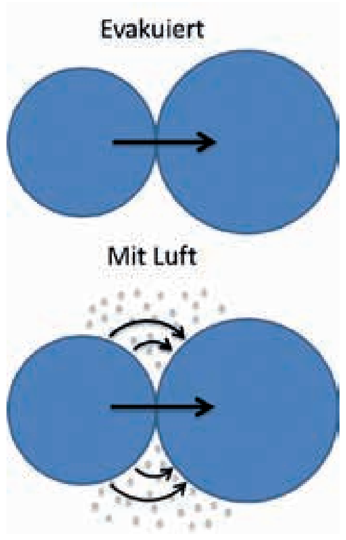
Robert Hofmockel offered an insight into the heat transport of bulk materials, which was not limited to the range of room temperature, but dealt with an extended temperature range up to higher temperatures. Bulk materials are a mixture of particles with a diameter of approx. 1 to 10 mm; in particular, these are expanded glass or expanded clay particles, which also exhibit internal porosity in addition to the hollow spaces between the particles (see figure expanded glass).

In general, the heat transport is composed of three elements: thermal conduction, radiation, and convection. The thermal conductivity of insulating materials, since they consist of different phases, can be subdivided into two components: gas and solid body heat transfer. The convection hardly plays a role in bulk materials. However, another effect additionally supports the heat transfer: the so-called coupling effect.

To quantitatively describe the different components of the heat transfer mechanisms, these can be determined by various measurements and evaluations to determine the thermal conductivity of the guarded hot plate. Due to the temperature-dependent measurement of the thermal conductivity of the evacuated expanded glass, and the extrapolation of the compensating curve towards low temperatures, the proportion of radiation is very small. The resulting value of the solid body contact heat conductivity is approx. 0.004 W/(m·K). This value, however, applies only to a very low pressure between the particles. A pressure-dependent measurement of the thermal conductivity results in an increase of approx. 0.005 W/(m·K) for a pressure increase to 1000 mbar, and thus a value of the thermal conductivity of the solid body contact at standard pressure of 0.009 W/(m·K). The air has a thermal conductivity of approx. 0.025 W/(m·K) at room temperature; thus introducing air into the evacuated bulk system should result in a thermal conductivity of approx. 0.034 W/(m·K). In reality, however, values are approximately from 0.060 to 0.070 W/(m·K). The coupling effect is responsible for this difference of approx. 0.030 W/(m·K) between expectation and the reality.

At temperatures ranging from 0 °C, the coupling effect plays an important role as a contribution to the overall heat transport, followed by the heat transfer of the air, the solid body contact between the particles, and the radiation. At higher temperatures, the proportion of the coupling effect decreases significantly, and the radiation contributes the largest share. The solid body heat conduction plays a subordinate role in the entire area, with a downward trend at higher temperatures, while the proportion of thermal conduction of the air remains almost constant over the entire temperature range.

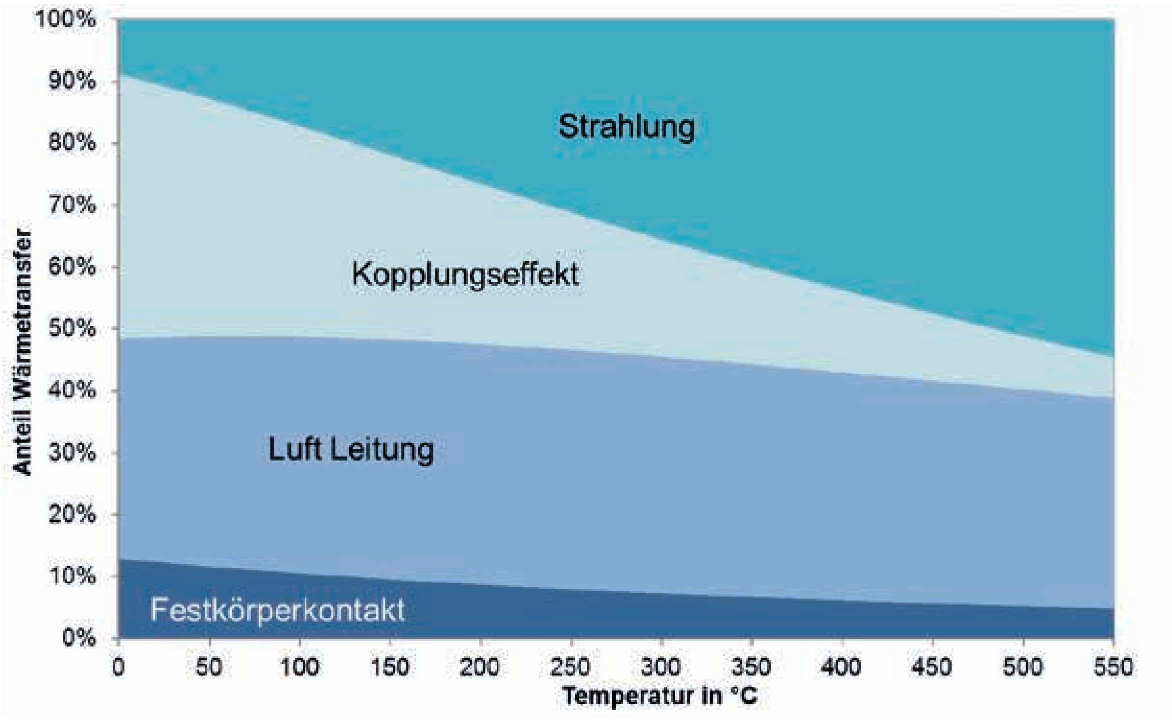
Thus a comprehensive model for heat transport in bulk materials could be developed, representing the transport mechanisms involved in the heat transmission, depending on the temperature.



↑ *schematic illustration of the coupling effect*

The developed modelling of heat transfer in bulk materials in the extended temperature range finds its application in the design and planning of heat storage in solar thermal energy.

↑ *Expanded glass: Left: loose granulate; centre: individual particles with a diameter of about 1 mm to 2 mm; right: cross-section of a particle; the inner porous structure is visible.*



↑ *Proportion of heat transport of bulk materials as a function of temperature*

Long-Term Performance of Superinsulating Materials (SIM) – the Activities of FIW Munich within the scope of IEA Annex 65
Christoph Sprengard

Christoph Sprengard presented the activities, which FIW supervises in the course of its cooperation in the developing IEA Annex 65 "Long-Term Performance of Superinsulating Materials (SIM)". The International Energy Agency (IEA) as a non-governmental organization (NGO) works to ensure reliable, affordable and clean energy. Currently 29 countries are members of the IEA, and support its work through direct financial contributions. Their main contribution is, however, the pledge of funding for national institutions participating in IEA projects. The participating countries hope to establish networks for future joint R&D projects, and to strengthen scientific cooperation (cross-cultural task). These IEA projects are called "Annex", and

are numbered consecutively. In the context of the "Energy in Buildings and Communities Program" (EBC), research and development activities for low and zero-energy buildings, reducing CO_2 emissions, energy saving, use of new technologies in practice, and influencing the energy saving legislation are supported nationally and internationally. The annexes have an average processing time of 3–4 years, a clear objective, and a precise definition of the expected results, and are meant mainly for publication and transfer of knowledge. The focus of the research of the EBC program are currently the integrated building planning and design, modern energy systems for buildings, the thermal building envelope, the concepts for municipalities and districts, as well as the actual energy consumption of buildings.
The objectives of Annex 65 "SIM" are to increase knowledge among the decision-makers and planners, and to raise awareness for new materials. From a technical perspective, the base should be set for determining reliable and reproducible data on the thermal and mechanical properties of these new materials, with a particular focus on durability and sustainability. This increases the safety of the properties in the applications, and forms the basis for standardization work on these materials. An important objective is the definition of clear and transparent accelerated aging methods. The IEA and EBC statutes rule out a development of products, and a research to expand the fields of application. As part of the work, no new measurement methods or devices are developed; instead, the existing methods are analysed to find out whether they are appropriate and accurate enough for these new materials. Appropriate adjustments to the framework conditions and evaluations may also be proposed.
FIW directs one of the four so-called subtasks (subprojects) of the existing measurement, calculation, and assessment procedures and their necessary improvements, and organizes exchange of knowledge between the participating institutes and manufacturing companies. During the research afternoon, Christoph Sprengard informed the participants on the progress of work, the categorization of the materials on the market that has started recently, the measurement, calculation and valuation methods, and the planned round robin tests to measure the thermal conductivity of the diverse, new materials.

Determining the sorption enthalpy of construction materials

Prof. Dr.-Ing. habil. Dr. h. c. mult. Dr. E. h. mult. Karl Gertis

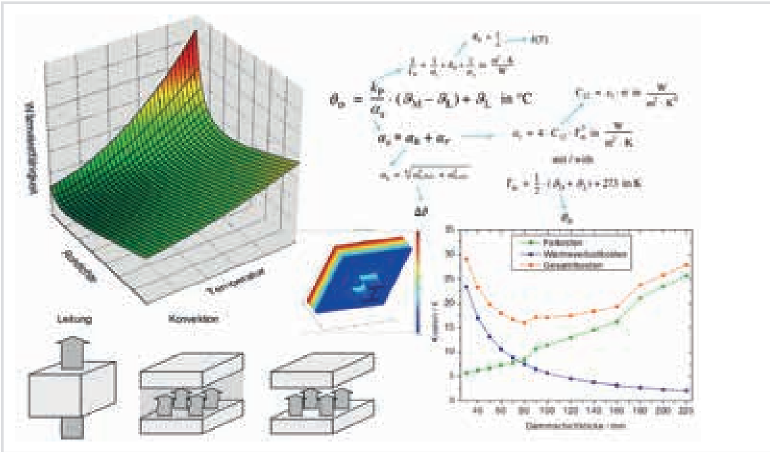
Although processes of water adsorption have been analysed intensively for a long time, technical literature provides only scarce information regarding the sorption enthalpy of building materials. However, such data is required for calculations of transient coupled heat and moisture transfer. In this context, latent energy is relevant, which includes the enthalpy of evaporation during the water/vapour phase change and the sorptive bonding enthalpy during water ingress in the pores of building materials.
For higher moisture contents, the sorption enthalpy does not depend on the material, but only on the gas constant and on the temperature, and it becomes negligibly small with the building material becoming more humid. If we have hygroscopic materials with small moisture content, the sorption enthalpy depends on the material properties, and it increases with decreasing moisture content. It can

be determined either by conducting calorimetric measurements or by measuring two sorption isotherms at two different temperatures. Due to a linear-logarithmic relationship, the measurement of merely two isotherms will be sufficient; it is not necessary to determine the entire isotherm family. The procedure of determination is exemplified specifying the individual calculation steps. From this, a simple formula for determining the sorption enthalpy can be derived.

For further information, please refer to:
www.fiw-muenchen.de/forschungsnachmittag_2015.php

Events, seminars, exhibitions

FIW Munich has been successfully organising seminars on heat and cold insulation of industrial systems for many years. This year, apart from training for insulation manufacturers, which was conducted in the institute building, seminars and training courses in the power plant technology were also held at plant engineering companies. The content can be customized to meet the wishes and requirements of customers. The trainings include the basics of heat transport and heat transfer, as well as calculations and application examples. The influence of moisture, and thus corrosion, under insulation, and profitability analyses in times of long-term rise of energy prices are clearly presented to the course participants. Last but not least, a look at the related standards, codes, worksheets, and product specifications is useful to round off the topic.



Teaching and lectures

Prof. Dr.-Ing. Andreas H. Holm
"Fundamentals of building physics"
Applied University of Munich

Presentations

Wolfgang Albrecht
- "Demolition, recycling and recovery of ETICS", Press conference to the joint research project on 21 January 2015 at the BAU 2015 exhibition in Munich
- "Recycling of ETICS" at FIW research afternoon on 20 May 2015

Robert Hofmockel
- "Modelling of heat transport in piles in the extended temperature range" at FIW research afternoon on 20 May 2015

Prof. Dr.-Ing. Andreas Holm
- "Is insulation really the right approach?" at the "Bau 2015" trade fair on 19 January 2015 in Munich
- "Options of interior insulation" on the FIW specialized event "Interior insulation" on 12 February 2015 at FIW Munich
- "Sense and nonsense of insulating house facades" at 27th Discussion Group Real Estate Dortmund on 5 March 2015
- "Development of new insulating materials - pioneering innovation or dead end?" at the Building Expert Days on 21 April 2015 in Aachen
- "Efficiency of thermal insulation methods" at FIW Thermal Insulation Day on 20 May 2015 in Munich
- "Efficiency of thermal insulation methods" at FIW research afternoon on 20 May 2015
- "Is the thermal insulation on target?" Lecture during the celebrations of the 350th anniversary of Saint-Gobain on 20 October 2015 in Paris
- "Recycling options of common insulating materials" at the Energy Consultants Day of the Energy Agency Rheinland-Pfalz GmbH on 5 November 2015 in Kaiserslautern
- "Energy efficiency: key to new growth" during the dena Energy Efficiency Congress on 16 November 2015 in Berlin
- "Is the energy revolution on target?" Lecture on 18 November 2015 at BI-Forum of the Technical College in Munich
- "Quality assurance as a need to achieve NZEB in new and refurbished construction" during the Workshop on upcoming 2020 building regulations in Denmark on 24 November 2015

Claus Karrer
- "Surveillance of thermal insulation products yesterday, today and tomorrow" at FIW research afternoon on 20 May 2015

Roland Schreiner
- "Energy efficiency, using cooling systems as a practice example" at KAIMANN-FORUM on 16 and 17 June 2015 in Hövelhof

Christoph Sprengard
- "Energy efficiency moving forward - from KfW standard to energy-plus house" at the expert forum "Future-proof building" of Klimaleichtblock, KLB, on 26 February, 4, 5 and 11 March 2015
- Initial presentation and management of the workshop: "ETICS technical approvals - quality features" at the Information Day in Munich Building Centre on 30 April 2015
- "Long-Term Performance of Superinsulating Materials (SIM) - The Activities of FIW Munich within the scope of the IEA Annex 65" at FIW research afternoon on 20 May 2015
- "Determination of linear thermal transmittance of VIP by measurement in a Guarded Hot Plate (GHP) or a Heat-Flow Meter (HFM) apparatus" at 12th International Vacuum Insulation Symposium in Nanjing, China, on 20.September 2015
- "Building sustainable with Insulation Materials" at expert forum of the Association of Housing Industry VHW in Frankfurt on 12 October 2015
- "Component-related estimate of the energy savings potential in the energetic renovation" at expert forum of the Association of Housing Industry VHW in Frankfurt on 12 October 2015
- "The tightening of EnEV as at 1 January 2016" at the Lime-Sand Brick building seminar 2015 in Munich and Hersbruck on 14 and 15 October 2015
- "The key to the energy transition (Energiewende) – requirements and potentials of building shell" at expert seminar "Energy efficiency and thermal insulation" by Puren, Überlingen, on 20 October 2015
- "The importance of thermal insulation of the building shell for the energy transition – materials, concepts, and efficiency" at IHK Energy Committee of the Chamber of Commerce and Industry Lake Constance-Upper Swabia region on 20 October 2015 in Überlingen

Publications

Holm, A. (2015):
Kellerdämmung – Von unten warm. [Basement insulation – warmth from below.]
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Holm, A. (2015):
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[Insulation is worth it according to the study.]
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In: ENERGIE, 2, P. 38–39.

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Hightech in der Gebäudehülle. [High-tech in the building shell.] In: Frankfurter Allgemeine Sonntagszeitung Verlagsspezial/Bauen, Sanieren und Finanzieren, B3

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Lohnt sich Dämmung? [Is insulation worth it?]
In: Supplement im Deutschen Ingenieurblatt, 6, P. 3

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Entwicklung neuer Dämmstoffe – zukunftsweisende Innovation oder Sackgasse?. [Development of new insulating materials – pioneering innovation or dead end?] at the Building Expert Days on 21 April 2015 in Aachen, exterior walls and windows (P. 109–113).
Wiesbaden: Springer Vieweg

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Energieeffizienzsteigerung durch Innendämmsysteme – Anwendungsbereiche, Chancen und Grenzen. [Increasing energy efficiency through interior insulation systems – application scope, opportunities, and limits.]
In EnEV aktuell, Book II, Beuth Verlag, Berlin

Diploma, Bachelor and Master theses

In collaboration with the University of Applied Sciences Munich and the University of Salzburg, the following student theses were supervised in 2015:

Maximilian Hummel
“Assesment of the time-dependent sorption behavior of wood fiber insulation materials”. University of Applied Sciences Munich, Faculty of Civil Engineering, Bachelor thesis.

Roxana Künzel
“Development of a new method to measure the specific heat capacity of insulating materials on full plates”. University of Salzburg, Engineering, Department of Chemistry and Physics of Materials, bachelor thesis.

Zacharias Kleber
"Behavior of insulating materials under the influence of moisture". University of Applied Sciences Munich, Bachelor thesis.

Imprint

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