

FIW München



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The supply of energy, the increase in energy efficiency, the success of the energy revolution in Germany, but also the transformation of the energy systems across Europe can only be achieved when energy savings are made.

Particularly because of and against the backdrop of the "climate protection agreement" that was signed last year, the climate protection goals that have resulted from it, and in the face of limited resources and the rising energy prices that this will cause over the long term, the treatment of and approach to the topic of energy will have to be given priority on the political agenda as one of the biggest challenges that the modern world is facing.

Finding answers to the aforementioned challenges is something that we included in our company's mission statement as we founded the company; and with the setting of the climate protection goals 2050 and the necessity to

have created near climate-neutral inventory of residential and non-residential buildings by that date, this is something that has become even more important than ever before.

This means that **thermal insulation equates to environmental protection**

and makes it the responsibility of all groups within society to tackle this cross-generational task and to assume an active role in overcoming these pressing challenges.

We accept these challenges. We contributed to establishing the basis of and then later the introduction of the very first energy saving act in 1976, and for this reason, it was only right that we also contributed to the wording of the Thermal Protection Ordinance in the following year in 1977.

On the 22nd of July, 2016, the Federal Energy Saving Act (EnEG) turned 40. The initial version of the Federal Energy Saving Act from 1976 served as the basis for the Thermal Protection Ordinance that was then introduced in 1977. The Federal Energy Saving Act (EnEG) today aims at ensuring that energy savings are made in buildings and that only so much energy is used as is actually necessary, and to use the building for that purpose for which it was actually designed and constructed. As early as the initial version, the thermal protection in the building envelope, as well as the efficient utilities equipment and its efficient operation were focused on.

The first Thermal Protection Ordinance and the amendments that then followed over the years, as well as the introduction of Energy Saving Ordinance EnEV 2002, have had a sustainable impact on the new construction of approximately 1.75 billion square meters of residential space (approximately 40% of the entire residential space). The quality of energy utilization and efficiency of the buildings since the introduction of the Thermal Protection Ordinance at the end of the 1990s has increased massively and in the meantime is multiple times better than that found in buildings built before and after the Second World War.

Despite the massive successes achieved through energy-saving construction methods over the past 40 years, we are still actually only beginning. If we look at the buildings throughout Germany in terms of their energy condition, it is apparent that 65% of all buildings in Germany are in need of renovation.

The goals with respect to the reduction of the primary energy requirement that the German federal government has formulated and wants achieved by 2050 are clear. Up to now, the impression could have been won that all political efforts within the wider framework of the energy revolution were directed at the electricity sector. The one-time new hope "Building Energy Efficiency" as an important building block, and in order that the building segment with its 18.7 million buildings, accounting for approximately 40% of the entire annual energy consumption, has been pushed into the background of the overall energy revolution discussion more and more over the course of the past number of years.

It is certainly to be welcomed that in 2016, the Federal Ministry for Economic Affairs and Energy (BMWi) in its "Grünbuch Energieeffizienz" (Green paper on energy efficiency) initiated the necessary discussion in order to drive forward the paradigm shift toward "Energy Efficiency First", while paying attention at the same time to achieving cost optimization. It has been recognized that the increase in the energy efficiency of buildings is of special importance for the energy revolution and the environmental protection. This is the path that will take us from the electricity to the energy revolution.

The newly rediscovered idea of the "Triad of the Energy Revolution" has been the most important fundamental constructional theory for years: "First the energy needs of a building are reduced and the remaining energy requirement is then efficiently covered with regenerative energies". Nevertheless, it remains the case today that 75% of the energy used in a residential building is required for heating, and that a portion of this is lost once again due to uninsulated building envelopes. This is unnecessary and does not reflect the latest technical standards. Practice has demonstrated that neither the exclusive increase in energy efficiency nor the exclusive concentration on rene-

wable energy sources is the universal solution. Quite the opposite, each building is individual. It is the planner's and the energy consultant's task, while amply taking the technology into account, of finding the economic and environmental optimum for each individual building.

A successful implementation of the energy revolution in buildings will not be achieved through quantity, but only through quality. It is therefore absolutely necessary to begin a quality and qualification offensive at the same time, because what is well meant also has to be done well in practice. In order to ensure that all the measures implemented in order to increase the energy efficiency of buildings indeed make a positive contribution to the energy efficiency, an increase or the maintaining of quality during the consultation, the planning, the execution and with respect to the materials is necessary. This is because although the technical solutions available today have proven themselves, they are at times very complex. Quality assurance measures are to be taken before, during and after the execution. In the event of a lack of quality, the promised goals cannot be achieved and, in extreme cases, can even result in structural damage and lead to associated recourse claims.

The energy revolution needs to be a path towards an economically successful and environmentally compatible future. This will entail us having to concentrate even more on innovation as is the case today. The FIW München sees itself as driver of innovation and has assumed a leading role in the new and further development of well-thought-out methods in the energy-efficiency sector. The development of new technologies, procedures, applications as well as services has always been part of the essence of FIW München.



**Klaus-W. Körner**  
Executive chairman  
of FIW München



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



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 thermal insulation.

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

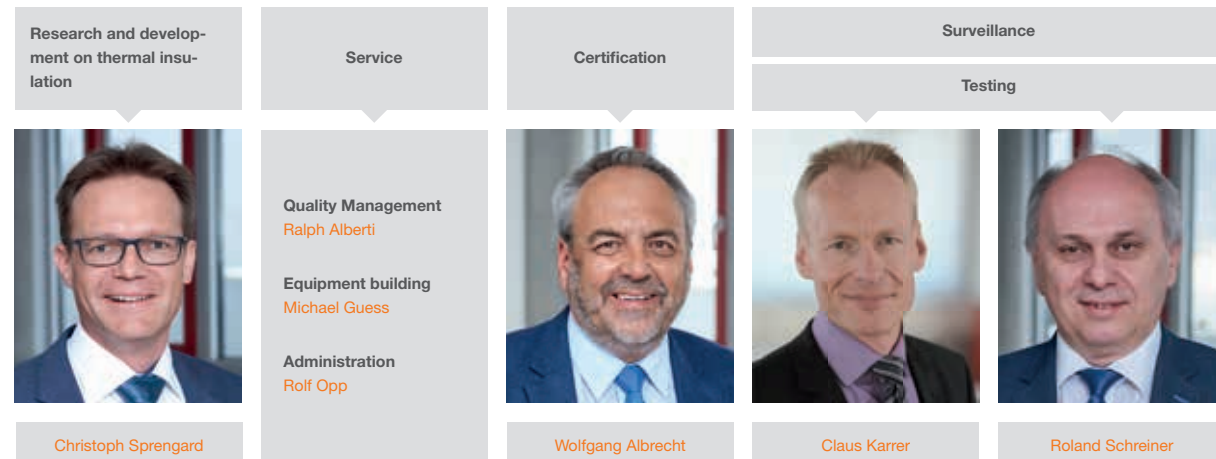
- researching the thermal and mass transfer laws, especially the scientific principles concerning insulation against heat and cold,
- disseminating this knowledge,
- thermotechnical testing of construction and thermal insulation materials and the constructions made from them (practical designs),
- cooperation with heat economy associations, technical associations and scientific institutes.

## Core competencies and business areas

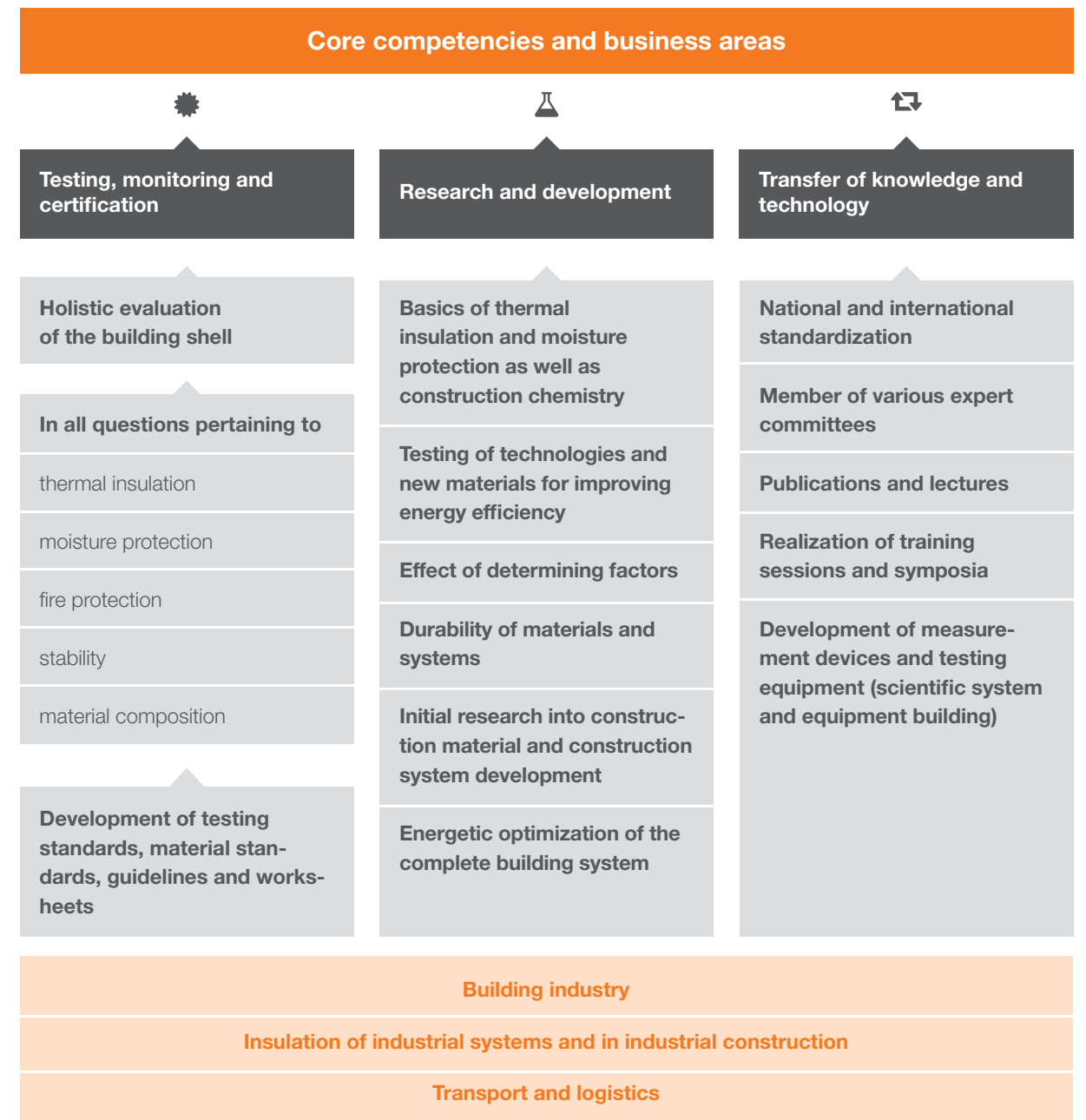
The structure and organization of FIW München is oriented to the business areas as well as to the classic core competencies. Core competencies and business areas of FIW München cover a wide spectrum. They cover, amongst other things, laboratory tests, open-air tests, development of measurement equipment,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



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



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 the institute's instructions within the scope of their activities.



## Financial development

The positive development in the HR department is also reflected in the institute's overall performance. In the 2016 fiscal year, FIW München generated revenues of 8.42 million euros. The sales volume has increased by more than 124% since 2000. Positive operational results have been constantly achieved since 2008. This is primarily based on the fact that the testing and monitoring activities were significantly expanded.

This trend is strengthened by increasing product variety, lower thermal conductivity and greater insulation material thicknesses. Revenues also positively developed as a result of voluntary monitoring systems.

Investments amounted to almost 0.5 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 2016, 67% were domestic and 33% were from abroad. The reason for this is that many customers have not only monitored their national factories by FIW München, but also their international factories. Furthermore, FIW München was able to establish its own monitoring system in several countries, together with partners from the industry. In addition, there are also increasing requests for research and development from abroad.

## Personnel development

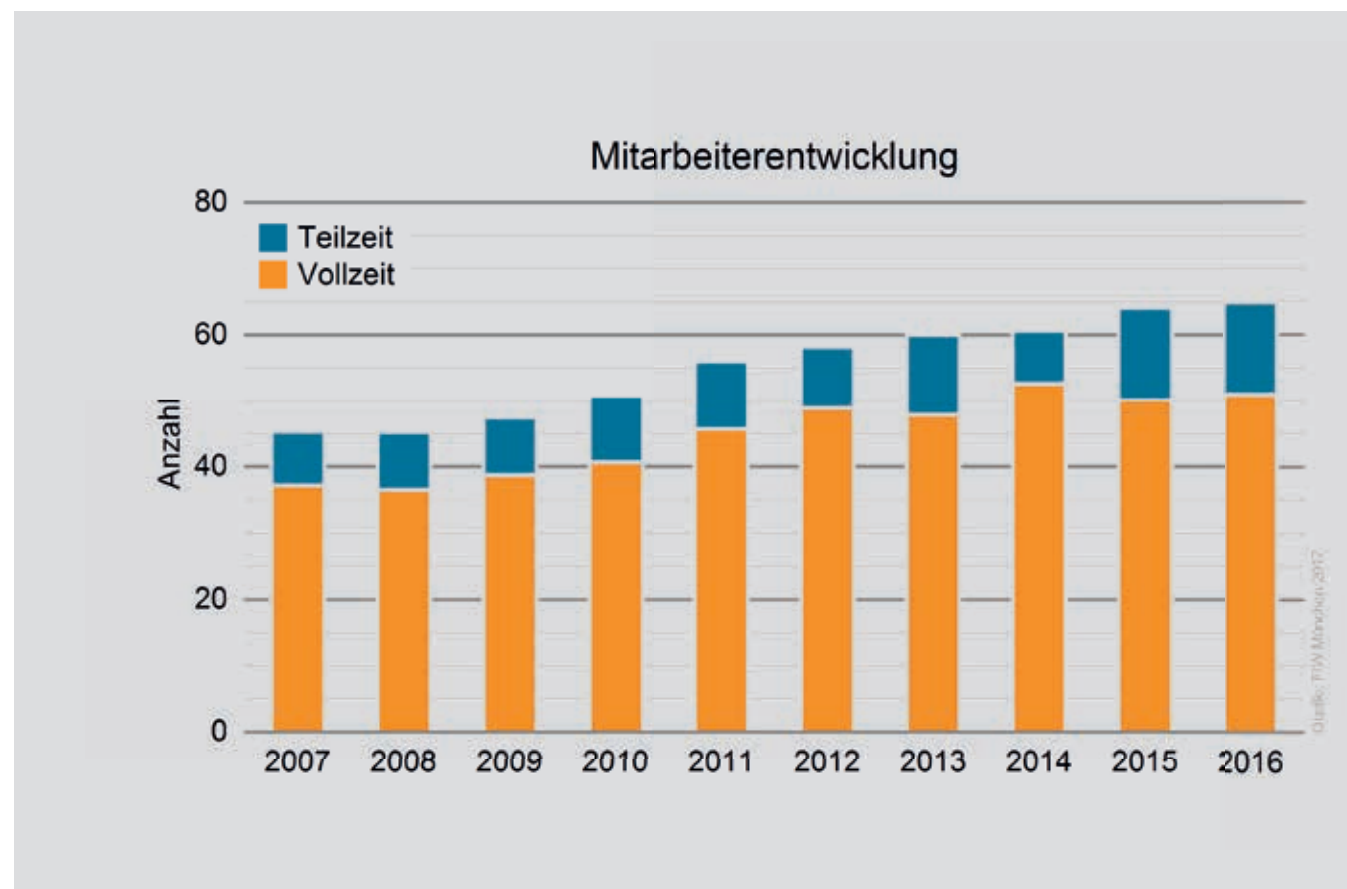
The number of employees has increased from 64 to 65 core staff (full-time equivalent) in comparison with the previous year. Together with temporary employees, 66 persons worked at the premises of the institute at the end of December.

The following employees celebrated service anniversaries during the past financial year:

Service anniversary

- 10 years of service**  
Jörn von Hohenthal
- 15 years of service**  
Renate Hirmer  
Christoph Sprengard
- 20 years of service**  
Uwe Glöß  
Christian Rank
- 25 years of service**  
Thomas Fischer
- 30 years of service**  
Roland Schreiner
- 35 years of service**  
Wolfgang Albrecht  
Sonja Preußner

The following diagram shows the positive employment development of FIW München during the past 10 years.



### Staff changes during 2016:

#### Entries

Christian Adrianowytch	01 January 2016
Andreas Seefelder	04 January 2016
Zhelyazko Fidanov	06 April 2016
Florian Kagerer	15 April 2016
Angéla Jakab	01 October 2016
Ramona Holland	15 October 2016
Kerstin Zehentner	01 December 2016

#### Resignations

Heike Richter	31 January 2016
Daniela Vetter	31 January 2016
Dr Wasyl Butko	31 March 2016
Maximilian Obermaier	31 July 2016



## Memberships and cooperations

### FIW München is a member of the following institutions:

- Allianz für Gebäude-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
- Deutsche Energie-Agentur (dena), Berlin
- DKV Deutscher Kälte- und Klimatechnischer Verein, Stuttgart
- DVM DEUTSCHER VERBAND FÜR MATERIAL-FORSCHUNG 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
- Vacuum Insulation Panel Association (VIPA International), USA
- Vereinigung der bayerischen Wirtschaft e. V. (vbw), Munich; (sponsoring member)
- VMPA Verband der Materialprüfanstalten 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.



## Testing and surveillance body

In traditional national conformity assessment of building products, the required tasks are allocated to a testing body for performance of product tests, a surveillance body for audits and sampling at the manufacturing plant, and a certification body for assessment of the test and audit results and for granting of certificates of compliance. In the future, this procedure, which is defined in the Building Codes of the German Federal States (Landesbauordnung - LBO), will only apply for a few thermal insulation materials without European product standard or European technical assessment (ETA).

The assessment of conformity of building products according to the European Building Regulation (EU BauPVO) does not provide for a surveillance body. All tasks will be performed by a certification body and a testing body, with the responsibility of the national surveillance body, i.e. auditing of manufacturing plants and product sampling, being allocated to the certification body. However, such body will be authorised to assign performance of some tasks to other bodies, e.g. the testing body. 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 EU BauPVO in the same manufacturing plant and in relation to the same insulation material. On the other hand, EU BauPVO states that staff members of the certification body may also adopt tasks of the surveillance body at the manufacturing according to the LBO. However, they are always competent contact persons for all questions regarding quality assurance and attestation of conformity of thermal insulation materials on national and European level.

This is particularly relevant as the ECJ judgement on the legal matter C-100/13 states that thermal insulation materials with European regulation must not be re-regulated nationally any more so that testing and, if applicable, certification by a notified body acknowledged in Europe will become even more important. On the other hand, the supreme building authorities of all Federal States defined in decrees on implementing BauPVO that general building control approvals can still be used for presentation of a building control level, provided that their incidental provisions, i.e. compliance with self-surveillance or ex-

ternal surveillance by a surveillance body acknowledged in accordance with LBO, are complied with. Thus, there will be further overlaps between the tasks of the surveillance body according to LBO and the notified certification body in the near future. This particularly applies to performance of voluntary certification programmes by the correspondingly accredited certification body of FIW München, which are described in detail in section 2.

The goal of FIW's laboratory is to offer all the tests relevant to insulation materials, or, in exceptional cases, to procure them in cooperation with other laboratories. The decades of experience of Europe's biggest laboratory for insulation materials 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 München, timely and in a competent fashion, to offer a certificate of suitability for the manufacturer's products.

FIW München is a national (testing, surveillance and certification body) 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 materials audit each other and define the measurement accuracy by round robin tests. In the area of technical insulation materials, 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 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 materials, 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 modelling, 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.

Also in the 2016 fiscal year, FIW München was involved in knowledge transfer in the field of heat and cold insulation. The basic documents in the field of "energy efficiency of industrial installations" are nearing completion in the VDI 4610 guideline committee. The expert committee for the revision of VDI 2055 Part 1 "Thermal insulation of operational installations in industry and in building equipment – calculation rules" continued its work consistently.

In 2016, many testing facilities were modernized and further testing capacities were created for the determination of long-term creep behaviour.



† Längenänderung von Dämmstoffen bei Tiefkälte

## 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, and 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 München 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 the test 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 of –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 the test regulations of DIN 52613, DIN EN ISO 8497

- within a temperature range of –70 °C to +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 DIN EN 1603
- dimensional stability under specified temperature and humidity conditions according to DIN EN 1604

#### Behaviour at higher temperatures

- maximum service temperature according to DIN EN 14706 and DIN 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 for fire protection and fire behaviour for construction materials

- non-combustibility test according to DIN EN ISO 1182
- gross heat of combustion according to DIN EN ISO 1716
- ignitability of products subjected to direct impingement of flame according to DIN EN ISO 11925-2

#### Mechanical properties

- properties, dimensions, density according to DIN EN 1602 and DIN EN 13470
- tensile strength according to DIN EN 1607, pull-off resistance, transverse tensile strength
- deformation under specified compressive load and temperature conditions according to DIN EN 1605
- compression behaviour according to DIN EN 826
- shear behaviour according to DIN EN 12090
- bending behaviour according to DIN EN 12089
- behaviour under point load according to DIN EN 12430
- coefficient of thermal expansion according to DIN EN 13471
- long-term compression behaviour, long-term creep test according to DIN EN 1606

#### Hygic properties and behaviour at freezing temperatures

- water absorption with full immersion according to DIN EN 12087
- water absorption at temperature change 20 °C/40 °C
- diffusion test 50 °C/1 °C according to DIN EN 12088
- water absorption with partial immersion according to DIN EN 1609



† Insulation materials

- moisture absorption according to DIN EN 322
- water vapour transmission properties according to DIN EN ISO 12572, DIN EN 12086, DIN EN 13469

#### Acceptance measurements

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

#### Other characteristics

- closed-cell nature according to ISO 4590
- cell gas composition with a gas chromatograph
- chloride contents and determination of pH according to DIN EN 13468
- thermal stability
- length-specific flow resistance according to DIN EN 29053
- non-fibrous component parts (shot content)
- ignition loss according to DIN EN 13820
- filament diameter
- determination of the absence of silicone in insulation materials



## Testing equipment and devices for insulation materials in building 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 DIN EN 13501-1, Class E and determination of ignitability according to DIN EN ISO 11925-2

### Testing of thermal conductivity of construction and thermal insulation materials according to the test standards of DIN EN 12664, DIN EN 12667, DIN EN 12939, ISO 8301, ISO 8302, ASTM C-177 and guidelines of DIBt, Berlin

- within a temperature range of  $-30^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  mean temperature
- at  $10^{\circ}\text{C}$  mean temperature

### Mechanical properties

- properties, measurements, thickness, bulk density
- thickness for floating floor insulation materials according to DIN EN 12431 (compressibility)
- tensile strength, pull-off resistance, transverse tensile strength (DIN EN 1607/1608)
- compression behaviour according to DIN EN 826
- shear behaviour according to DIN EN 12090
- bending behaviour according to DIN EN 12089
- behaviour under point load according to DIN EN 12430
- dynamic stiffness according to DIN EN 29052-1
- coefficient of thermal expansion according to DIN EN 13471
- settlement after vibration
- settlement after climate testing  $40^{\circ}\text{C}/90\%$  r.h.

- determination of compressive long-term creep according to DIN EN 1606 up to a thickness of 300mm
- dowel pull-through strength according to ETAG 004

### Hygic properties and behaviour at freezing temperatures

- water absorption with full immersion according to DIN EN 12087
- water absorption at temperature change  $20^{\circ}\text{C}/40^{\circ}\text{C}$
- diffusion test  $50/1^{\circ}\text{C}$  according to DIN EN 12088
- freeze-thaw resistance and compression test according to DIN EN 12091
- water vapour transmission properties according to DIN EN ISO 12572, DIN EN 12086, DIN EN 13469
- equilibrium moisture content according to DIN EN 12429
- sorption humidity of building products according to DIN EN ISO 12571 (DIN 52620)
- water absorption with partial immersion according to DIN EN 1609
- moisture content according to DIN EN 322

### Dimensional stability/ shape stability

- dimensional stability under constant normal conditions according to DIN EN 1603
- dimensional stability under specified temperature and humidity conditions acc. to DIN EN 1604
- deformation under specified compressive load and temperature conditions according to DIN EN 1605

### Other characteristics

- closed-cell nature according to ISO 4590
- cell gas composition with a gas chromatograph
- chloride content of HWL panels according to DIN EN 13168
- length-specific flow resistance according to DIN EN 29053

## New measuring and test equipment

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

The test facilities are used for long-term study of the deformation behaviour of insulation 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.

Since 2014, the test capacities have been expanded continuously and adapted to the new requirements for thickness of insulation materials and for load. In 2016, further test stands for tests with a thickness of up to 300mm were constructed and taken into operation.

The testing equipment continuously and automatically detects the deformation with high-precision distance sensors. This allows for recording of deformation within a tight time grid beyond the requirements for the standard.

The load is applied evenly and continuously through gravity and lever arms, and is thus independent of technical equipment.

Contact person: Stefan Sieber

### 2. Testing facility for the determination of freeze-thaw cycling according to EN 12091 – upgrade

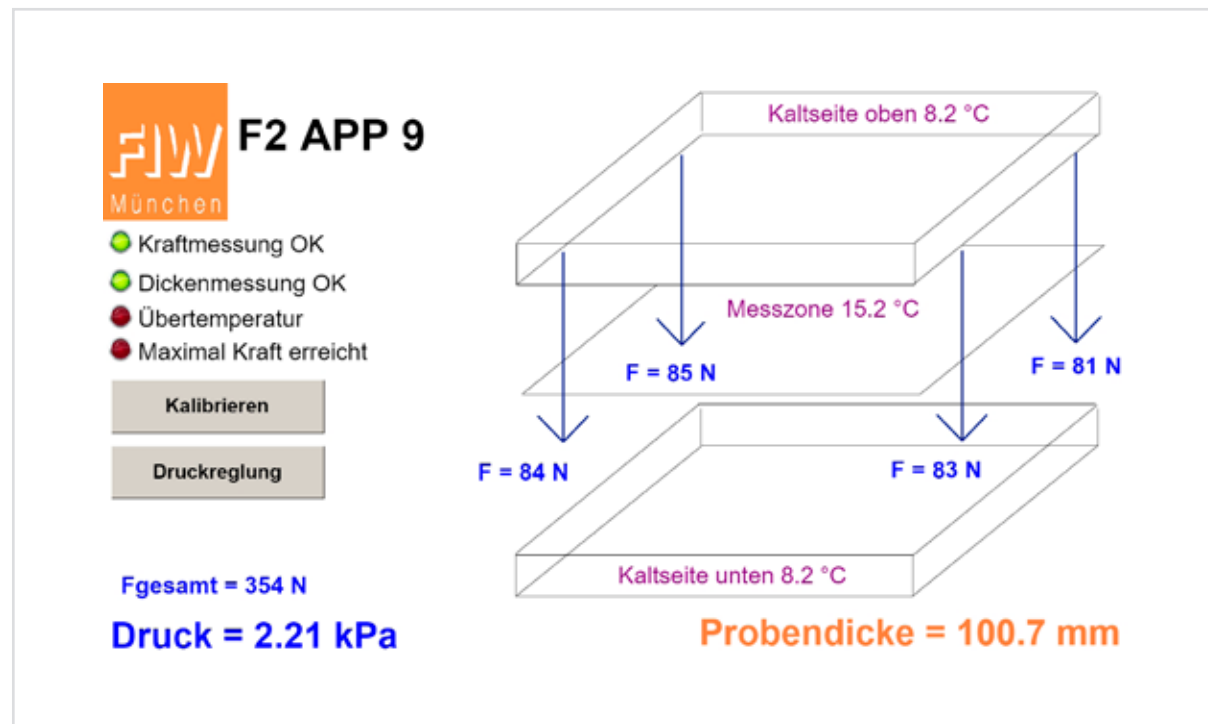
Thermal insulation materials, which are exposed to moisture (inverted roof, perimeter insulation) when being used out of the building seal, are tested (after 300 cycles of one-hour storage each at  $-20^{\circ}\text{C}$  and sub-water storage at  $+20^{\circ}\text{C}$ ) with regard to change under compressive stress and with regard to water absorption. For moistening of the test bodies, usually the “determination of water absorption through diffusion” according to EN 12088 is preceded to the freeze/thaw cycling test.

After more than 15 years, the test standards are subject to review. This requires examinations regarding the test sequence. Using the upgraded units, valuable information can be collected within scope of research projects and Bachelor theses. In 2017, a new unit with changed test sequence will be developed to obtain further knowledge on the effects of the test procedures on the results.

Contact person: Stefan Sieber



† Langzeitkriechverhalten



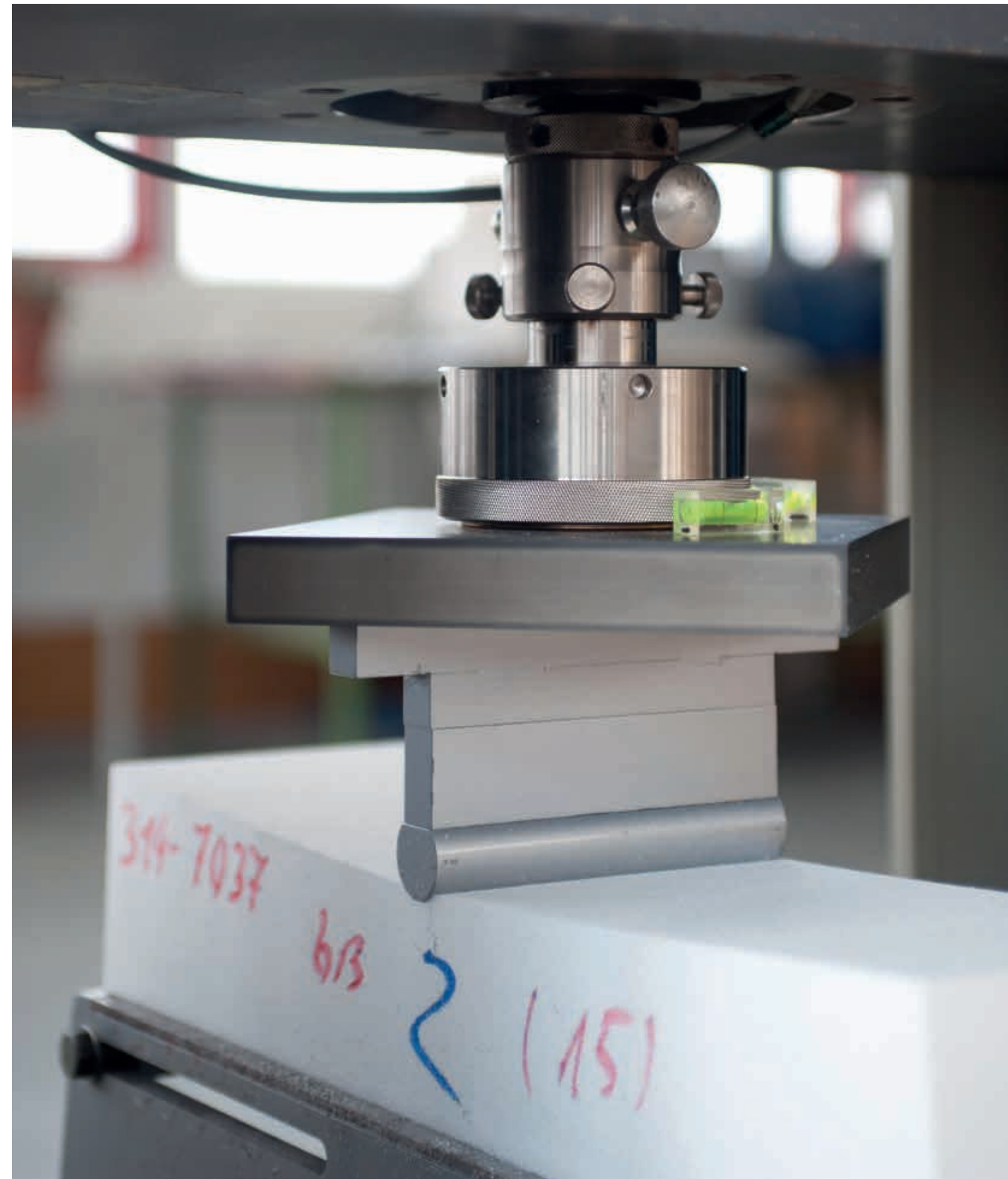
**3. Extension of test method for determination of thermal conductivity by measuring pressure distribution during measurement**

Last year, an additional function was added to a testing facility for measurement of thermal conductivity. Now, apparatus 9, a two-plate apparatus for small test body dimensions, is able to record the compressive stress applied on the test body during the test. For this, high-precision weighing cells were attached at four locations below the test surface, enabling measurement of total pressure and pressure distribution onto the test body. Pressure distribution can be shown via a display installed on the apparatus and allows for monitoring of the thermal contact of the sample to the apparatus surfaces, which is an important prerequisite for optimum thermal transmission.

Moreover, acquisition of measurement data of apparatus 9 was further developed. In addition to pressure recording, also the thickness of the test body can be monitored over time. This is particularly interesting for measurements of thermal conductivity over a larger temperature range as here the thickness of the test body may change due to thermal expansion or contraction. In such case it will be

possible now to control the set thickness of the insulation material, based on the distance between heating and cooling plates, according to a defined constant contact pressure during measurement to reliably ensure thermal contact. Further apparatuses should be equipped with such technology in the foreseeable future.

**Contact person:** Anatoli Manski





### New certification systems of FIW München

In October 2016, the Ü-mark was discontinued in Germany with regard to construction and insulation materials that are controlled by a European standard. The Ü-mark certified that all building control requirements regarding quality of a construction product were monitored and complied with. As the Ü-mark is not available any more for building contractors, architects and planners in most cases, the responsibility of the manufacturers to prove the quality of their products by other means increased. Already during the first six months of 2016, with regard to implementation of the ECJ judgement it became more and more apparent that only voluntary certification systems can be used for proving the quality of construction and insulation materials in the future. As a matter of fact, these certification systems should be compatible with EU law. After FIW München has been dealing intensively with a voluntary quality system during the past years, this could be used as a basis and a multitude of voluntary certification systems could be completed and provided to our customers.

### Insulation KEYMARK (Keymark 2.0)

Elaboration and implementation of the KEYMARK programme rules 2.0 by the Quality Assurance Committee (QAC) of the KEYMARK Scheme Development Group (SDG-5), managed by Mr Roland Schreiner, represented an important milestone. With previous "product certification" of technical insulation materials, all properties were checked with every product, but in case of structural engineering product often only thickness and thermal conductivity were tested according to EN 13172, Appendix A. Then, additional properties were requested within scope of technical or national requirements. In most cases, fire behaviour was controlled in the "Certificates of constancy of performance" (often also called CPR certificate) required as per EN Standard System 1.

Now, the challenge is to define rules for certification meeting the requirements for the products of various manufacturers. Thus, manufacturers of technical insulation materials usually have a manageable product portfolio with a comparably low number of exactly defined products. By contrast, the manufacturers of mineral wool often have 100 to 200 products in their product portfolios. Corre-

spondingly, product certificates and groups' certificates were developed within scope of Insulation KEYMARK to meet the various requirements. In addition, the fire behaviour according to EN 13501 has been integrated as a property to be tested.

Now, Insulation KEYMARK offers the possibility to offer both product certificates and groups' certificates to the various manufacturers. The scope of testing has been extended as compared to the previous scope according to EN 13172, Appendix A, so that all declared levels, classes and nominal values will be tested at least once per year in the future. The fire behaviour will be tested once every two years according to the EN standards. The rules for grouping and selection of the critical product representatives to be tested in case of properties that have an impact on each other were defined in the "Insulation Keymark Scheme Rules Appendix F".

The new KEYMARK rules were presented at the KEYMARK Conference in Berlin on 10/11 October 2016, a few days before expiry of the deadline for implementation of the requirements based on the ECJ judgement.

Since October 2016, the FIW München has been offering to the manufacturers of insulation materials the KEYMARK certification for the following insulation materials:

- mineral wool according to EN 13162 with FIW implementing regulation
- XPS insulation materials according to EN 13164 with the certification programme application of thermal insulation materials made of XPS for buildings according to DIN 4108-10
- wood wool insulation materials according to EN 13168 with FIW implementing regulation
- all technical insulation materials with European product standards

### Certification programme for thermal insulation materials for buildings, made of polyurethane (PU)

Furthermore, another certification programme for PU insulation materials was developed in cooperation with ÜGPU Stuttgart. This certification programme is open for all manufacturers of PU insulation materials, irrespective of being an ÜGPU member or not and irrespective of the produc-

tion site being located in Germany or abroad. The certification programme for PU is for testing all significant properties, including the property of gas diffusion-tight cover layer and cell gas composition. All insulation materials externally monitored according to this certification system, whose manufacturers are also member in the ÜGPU, are identified with the Q-mark of ÜGPU.

### Certification programme for ETICS insulation materials made of expanded polystyrene (EPS)

Since 2012, FIW München has been offering an external surveillance system for ETICS insulation materials made of EPS, acting as an interface between the insulation material and the ETIC system. After successful accreditation for voluntary certification programmes according to EN ISO/IEC 17065, FIW München developed a "certification programme for ETICS insulation materials" by involving the corresponding ETIC manufacturers and insulation material manufacturers. The new certification programme replaces the previous voluntary surveillance of ETICS insulation materials that served as a proof of quality at customers and surveillance and certification bodies up to now.

Since 2016, FIW München has been offering the following certification programmes for ETICS insulation materials:

- **certification programme for ETICS insulation materials made of expanded polystyrene (EPS):**  
two audits per year, one without prior notification, sampling and testing of two nominal thicknesses per year
- **extended certification programme for ETICS insulation materials made of expanded polystyrene (EPS):**  
two audits per year, one without prior notification, with two complete tests and a total of four tests of thermal conductivity and tensile strength

### VDI quality assurance as per VDI 2055

VDI certification can be requested for technical insulation materials also without European product standard and for properties beyond the regulations in the European product standards. Above all the AGI working documents of the Q-series defined requirements, which must be secured by a voluntary surveillance system, for many technical insulation materials. Here, VDI quality assurance represents a quality assurance system for insulation materials requested for decades in the technical specifications by the operators of industrial plants for creation of heat and cold insulations. Also here, FIW München being an acknowledged certification body represents a competent partner. In the meantime, a multitude of certification contracts for all voluntary certification systems were concluded, and several certificates were issued. Further certification programmes for other thermal insulation materials are planned or can be developed in case of need.



## Overview

The department of research and development in thermal insulation combines the research activities of the institute. Main focus is on hygrothermal optimisation of insulation and construction products as well as components and insulation structures. The further developments processed within such scope are increasingly accompanied by simulations. However, the quality of such calculations depends on the reliability and accuracy of the material data “fed” into the programmes. In order to not leave this to chance, FIW München provides modern devices and test machines to rapidly and reliably determine material parameters. Above all in this regard, FIW München continuously extends its test offer, e.g. with regard to the determination of material parameters for hygrothermal simulation of internal insulation systems. The simulations with components and units can be verified by means of tests with whole components/units such as facade elements, windows, gates, masonry and technical insulation systems with a 1:1 scale.

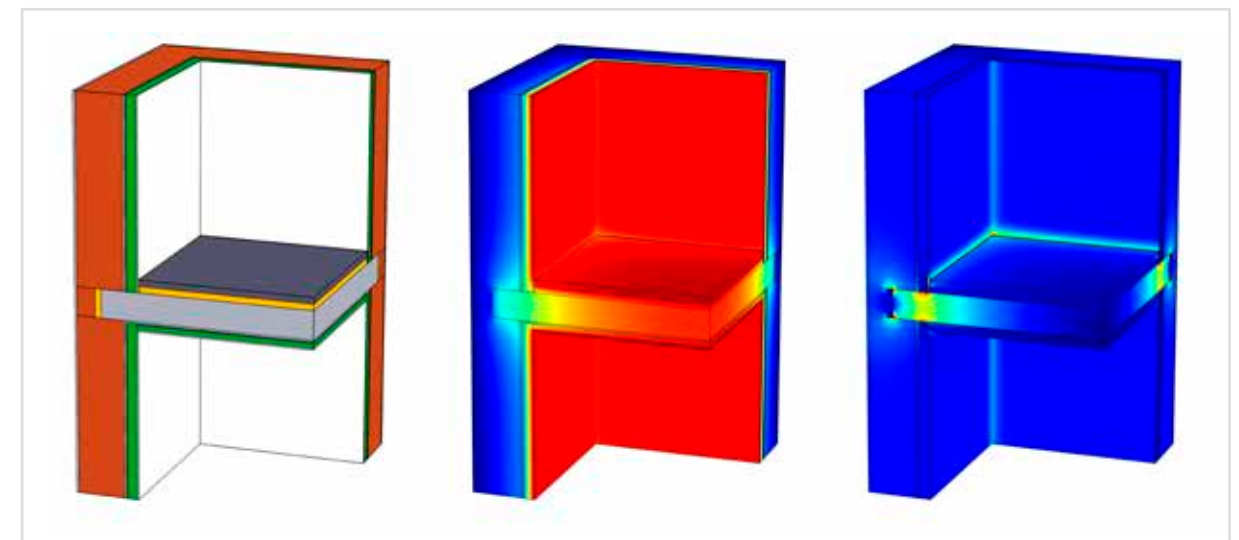
Particular strength of the “R&D” is the flexible combination of calculations, simulations and laboratory examinations. Above all with regard to new insulation materials and construction products such as vacuum insulation panels (VIP), insulation materials on the basis of aerogels and microporous materials (APM, “advanced porous materials”), moisture-adaptive vapour barriers, low-emission coated insulation films or masonry blocks filled with insulation material, there are no reliable material values as a basis for numeric calculations. “R&D” determines such material values as basis for calculatory examinations of the product and accompanies the manufacturers on their way to the market.

In this connection, the know-how of the department regarding heat and humidity is also open for other industries: planners and manufacturers of chemical and power plant-related systems, manufacturers of cooling and freezing devices, air conditioning, transport containers and vehi-

cles access our expert knowledge to optimise the thermal behaviour and the long-term behaviour of the application. Here, stationary consideration of heat transfer will not be sufficient any more in the normal case, but changeable boundary conditions must be used as a basis, e.g. daily or annual hydrographs of temperature or climate data exact to the hour for a multitude of locations. Often, such temperature profiles are also created in combination with realistic humidity conditions to analyse the distribution of humidity within the system or to exclude possible damage to the structural design right from the beginning. Then, the examinations in the laboratory and the simulations can be evaluated locally by means of a monitoring.

Here, the “R&D” department monitors the whole value chain – from material to the component and from the component to the complete heat-insulating building shell. A holistic view considers the location of the building, the climate and even the user behaviour of the residents to be able to make reliable statements on permanent functioning of structures and refurbishment measures.

In the 2016 fiscal year, the ongoing research projects on “Increase of energy efficiency with internal insulation systems”, commissioned by the Federal Ministry for Economic Affairs and Energy (BMWi) and sponsored by Projektträger Jülich (PTJ) and supported by the collaboration in the emerging IEA Annex 65 “Long Term Performance of Superinsulating Materials SIM”, which is also sponsored by PTJ, could be continued successfully. Furthermore, again a multitude of minor and major projects could be acquired and processed during 2016. Here, the successful application for an EU project in the Horizon 2020 programme of the EU Commission on further development of vacuum insulation panels with a total of 12 European partners, “INNOVIP”, is a particular highlight. Regarding this project, FIW München is responsible for coordination of the project, which is funded with approx. 5 million euros. Further minor and major projects refer to issues on mea-



† thermische Gebäudesimulation

surement of compression stress and internal pressure of vacuum panels, drying behaviour of masonry, and questions regarding the economic efficiency of the insulation level in Germany on behalf of the Deutsche Gesellschaft für Mauerwerks- und Wohnungsbau. The stated projects are further detailed in the “Highlights from research and development” section.

Ms Ramona Holland, who has been dealing mainly with thermal building simulation within scope of her Bachelor degree in Civil Engineering since October 2016, joined our team.

## Research and development options in the field of thermal insulation

### Research

- Processing of research projects, concerning all fields of hygrothermal 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 users' consumption patterns
- Estimates of potential for refurbishment

### Development of products and materials

- Optimization of hygrothermal characteristics of insulation and building materials, and of construction parts and insulation systems
- Monitoring of further developments of materials, products, components and building parts with calculation and simulation using modern computer programmes
- 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 3.5 x 3.5 m component size
- Combination of numerical calculations, simulations and laboratory testing for new construction products (e.g. vacuum insulation panels (VIP)), moisture-adaptive vapour barriers, low-emission coated insulation films, or masonry blocks filled with insulation material) and scientific support up to the market launch of the product

- Calculations, simulations and testing of hygrothermal characteristics also for other sectors, e.g. cooling and freezing equipment, transport containers and cooling trucks
- Monitoring of the whole value chain– from material to the component and from the component to the complete heat-insulating 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 refurbishment measures
- Surveys and assessments of potentials
- Catalogues of thermal bridges
- Support concerning technical manuals and product documents

## Highlights from research and development

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

*Christoph Sprengard, Christine Maderspacher, Sebastian Tremel*

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, clear labelling of 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 ageing methods as well as the development of appropriate testing and calculation methods by analysing their area of application under boundary conditions. In September 2015, a large round robin test was launched for this purpose, which could be completed at the end of 2016 and that is currently being assessed for the final report of Annex 65. A total of seven different vacuum insulation panels (VIP) and aerogels (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 ageing steps. For acceleration of the ageing of the samples, storage at 50 °C and 70% rel. humidity is applied for a total of six months. This ageing method corresponds to the draft of the CEN TC 88 WG 11 Task Group Ageing,

which will be incorporated also in the emerging product standard for vacuum insulation panels in the future. The same conditioning is also used for half of the APM samples. For comparison, the other half is conditioned at 80 °C and 60% rel. humidity. FIW München is responsible for coordination and evaluation of the round robin test.

A project meeting will take place every six months to communicate the current project progress and to discuss the results. Elaboration of Annex 65 will be finished in summer 2017, and the final workshop for presentation of results and reports will be held at Paris in September.

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

*Christoph Sprengard, Holger Simon, Christine Maderspacher, Max Engelhardt, Florian Kagerer*

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-year project period, a safe evaluation and assessment system of interior insulation constructions in terms of prolonged reduction of transmission heat losses and structural-physical boundary conditions is to be worked out. The results and knowledge gained from the “Increase of energy efficiency through interior insulation systems” research project should be provided to

the planners and users and enable them to perform safe validation of the structural-physical risks of interior insulation structures. This should result in increased use of interior insulation systems, correspondingly enabling optimal exploration of the energetic potential.

In 2016, the project has been continued in accordance with project planning, and work packages on thermal bridge issues and on hygrothermal measurements could be completed.

**High-tech building insulation**

The EU requirements are ambitious: until 2050, private and office building in Europe should lower their carbon footprint by approx. 80 percent as compared to the 1990 level. Here, optimal thermal insulation plays a decisive role. Vacuum insulation panels (VIP) are a highly insulating material in this field, but currently they are quite expensive and sensitive during processing. Moreover, the service life of the panel should be increased to reach a high acceptance on the market. The INNOVIP project, which is sponsored with 5 million euros from the EU, wants to solve those problems by using innovative technologies and developing new materials.

Vacuum insulation panels currently on the market usually consist of a core made of compressed pyrogenic silica or mineral fibres. Employing novel high-barrier film as well as alternative filler materials, e.g. ground perlite, the INNOVIP consortium, which is composed of research facilities and companies from seven EU states as well as Israel, wants to render this highly efficient solution more competitive. In this regard, FIW München coordinates the research project on behalf of the EU Commission. The project partners established the following individual goals:

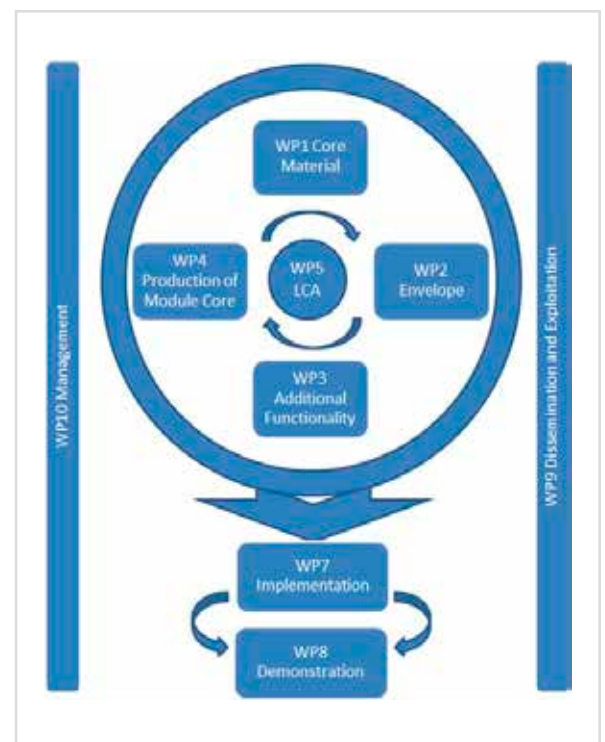
- increase of insulation efficiency by at least 25 percent with simultaneous significant increase of service life,
- standardised minimum service life of 25 years with minimal wear,
- development of innovative production process for the insulation panels that significantly simplifies the efforts for wrapping the support cores with film, correspondingly lowering the manufacturing costs by up to 30 percent as compared to the VIPs that are offered at the moment,

- implementation of numerous additional functions and simplification of assembly,
- lowering of manufacturing costs by 30 percent as compared to the VIPs that are offered at the moment,
- reduction of specific costs for insulation measures by approx. 30 percent as compared to established vacuum systems and customary insulation material (styrofoam, mineral wool), also considering the insulation performance (as compared to the costs per square metre for insulation systems with identical performance),
- implementation of numerous additional functions, amongst others against mould, and simplification of assembly.

Here, the films enclosing the porous core material play a decisive role. Current VIPs are highly efficient already, but such performance inevitably decreases over the years. This is caused by the increase of the interior pressure due to the slow ingress of air and water vapour into the vacuum elements. This results in an increase of their thermal conductivity, i.e. the insulation performance will decrease. Correspondingly, the new design of the wrapping films as planned by the INNOVIP project partners should offer a permeability to water vapour and air that is at least 40 percent lower, this granting a good insulation effect for up to 50 years.

The combination of several production steps significantly simplifies the work-intensive film-wrapping of prefabricated support cores. The use of bulk powder made of pyrogenic silica allows for a lower pressure of the filler material as compared to compressed plates, directly resulting in savings with regard to material costs and thus also production costs. Furthermore, the lower density even reduces the thermal conductivity in the support core.

The improvements of the films allow for future use of significantly more cost-effective core materials as compared to the pyrogenic silica used up to now, e.g. expanded perlite. Perlite offers significantly larger pores, meaning higher requirements for the vacuum in the panels and thus also for the tightness of the employed film. Vacuum panels with perlite, which is also called volcanic glass, have a thermal conductivity that is approx. one third high-



† Workflow

her as compared to panels with silica cores, but they also offer a significantly more cost-effective production. Moreover, the design of the panel edges is improved and assembly is optimised to offer an insulation performance that is as efficient as possible. This reduces thermal bridges when putting the panels together. Additional efficiency gains could be achieved by using microporous materials (APM – advanced porous materials) as additional insulation in the gap between the panels mounted on a building.

The workflow shows the linking of the work packages (WP). In WP 1 – 4 the various developmental fields of core material (WP1), film wrapping (WP2), extended functions (WP3) and production technology (WP4) are processed and optimised in conjunction by applying sustainability concerns (WP5) before development of suitable applications for various design versions of the panel is made in WP 7. Demonstration projects (WP8) and measures for distribution of the results (WP9) finally confirm the achieved results. The INNOVIP project ("Innovative VIPs with multi-functionalities for the building sector" – Grant Ag-



† Members of the INNOVIP research consortium at the kick-off meeting in Brussels (5 and 6 October 2016)

reement No. 723441) supported by the European Commission was started in autumn 2016 and will be funded with approx. 5 million euros from Horizon 2020, the EU Framework Programme for Research and Innovation, until 2019. 13 companies and research facilities from seven European states plus Israel are involved in the project. INNOVIP is coordinated by FIW München. The Bavarian medium-sized companies va-Q-tec AG from Würzburg, the Fraunhofer-Institut für Verfahrenstechnik und Verpackung IVV in Freising as well as the Bayerische Forschungsallianz GmbH from Munich are further German partners.



### Long-term behaviour of wetted insulation materials on flat roofs

Experience from practice and heat flow measurements  
Ramona Holland, Sebastian Tremel

The condition of the insulation material represents a significant criterion for deciding whether the structure of flat roof surfaces can be maintained or should be stripped when performing refurbishment measures with existing buildings. If the insulation material has a certain moisture content, then this often is a reason for stripping and disposal although many of the currently used insulation materials on principle mechanically remain fit for use over longer periods also in case of high moisture content, which is proven by means of several surveys.

The "Status changes of mineral wool insulation materials in insulated flat roof structures due to ingress of moisture" research project performed by FIW München and the Aachener Institut für Bauschadensforschung und angewandte Bauphysik gGmbH (AIBau) and completed in 2012 could establish that time-dependent changes of compressive strength primarily are a result of too high and repeated mechanical load and are only dependent on moisture load to a minor extent.

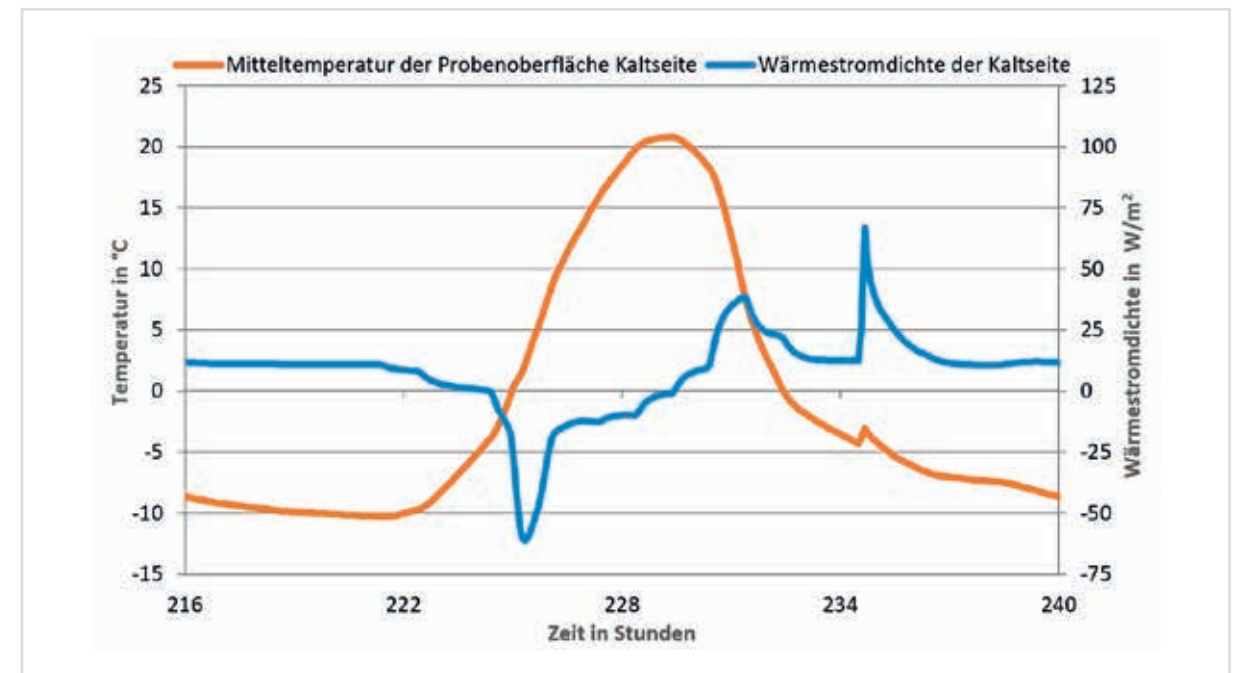
However, the long-term effects of moisture content on the thermal transfer within the insulation are not sufficiently clear yet. Particularly the distinction between changes of the actual thermal conductivity of the material and an increased thermal transfer by (reversible) diffusion processes and latent thermal effects in case of cyclic phase transitions have not been examined sufficiently yet.

In this context, laboratory examinations with various insulation materials currently are performed at FIW München to characterise the dependency of thermal transfer on the moisture content under stationary and transient temperature conditions. The measurements are part of a currently ongoing research project under the title "Long-term behaviour of wetted insulation materials on flat roofs – Experience from practice and heat flow measurements", which again is performed by FIW München and AIBau.

Here, the task of FIW München particularly is to assess the remaining insulating effect of a selection of typical insulation materials in case of humidity contents typical for certain damages. The insulation material types XPS, EPS, PUR as well as mineral wool are subject to examination. When

measuring the thermal conductivity of wet insulation materials, there are various moisture transport processes within the sample which have an effect on the thermal conductivity. The impressed temperature gradient induces a transfer of moisture that, depending on the individual sorption behaviour and water vapour diffusion resistance, is differing in speed. On the one hand, thermal transfer is impacted by the change of the thermal conductivity of the solid material in case of differing humidity (in case of hygroscopic materials), and on the other hand also by the heat of the diffusing water molecules. Also the latent heat effects occurring during condensation and evaporation as well as the heats generated during adsorptive and desorptive processes have an impact on thermal transfer. If there are transient temperature conditions, as this is customary under conditions of building practice, the stated phenomena are also temporally differentiated.

The figure shows an example of an extract from the transient measurements with a wet insulation material. Diurnal variation of temperature on the cold side (orange line) and the corresponding heat flow density (blue line) are shown. It can be seen that the heat flow density follows the changes of temperature in a temporally delayed and discontinuous manner, which is due to the impact of moisture within the material. This project is supported by financial means from the Forschungsinitiative Zukunft Bau of the BMUB.



† extract from measurement results of a wet insulation material in case of transient measurements

### Economic efficiency of single-family houses with lowest-energy building standard

Study on behalf of Deutsche Gesellschaft für Mauerwerks- und Wohnungsbau e.V. (DGFM) in 2016

Florian Kagerer, Andreas Holm, Christine Maderspacher

National implementation of EU building efficiency directives and further development and merging of Energy Saving Act (EnEG), Energy Savings Ordinance (EnEV) and Renewable Energies Heat Act (EEWärmeG) included in the new Building Energy Act (GEG) also provide for an increase of requirements for thermal quality of the building shell and on efficiency of the supply systems. In accordance with the time schedules formulated by the EU, all buildings newly constructed and funded by the public sector as of 2019 and all other newly constructed buildings as of 2021 should be designed as nearly zero emission buildings (NZEBs).

Whilst available technology and concrete measures already allow for significant savings potentials for reduction of

greenhouse gas emissions in case of new buildings or comprehensively performed refurbishments, there will be a certain "last-mile problem" in case of further reductions of emissions towards zero: the higher the savings on the total CO<sub>2</sub> balance, the higher the costs and efforts for the measures to be initiated. For limitation of cost increases, the EU directive includes the general requirement that the future building standard should achieve a least-cost level based on required investments and possible savings.

In the first drafts of the Building Energy Act, the future nearly zero emission building corresponds to the current "Effizienzhaus 55" (Efficient Building 55) development standard of the KfW-Bank. Using a study on the basis of a typical German single-family house, the economic viability of efficiency measures at the building shell was examined for massive building structures in cooperation with the Arbeitsgemeinschaft für zeitgemäßes Bauen e. V. The objective was to perform energetic and economic assessment of various thermal qualities of the building shell in combination with various supply technologies, and to dedu-

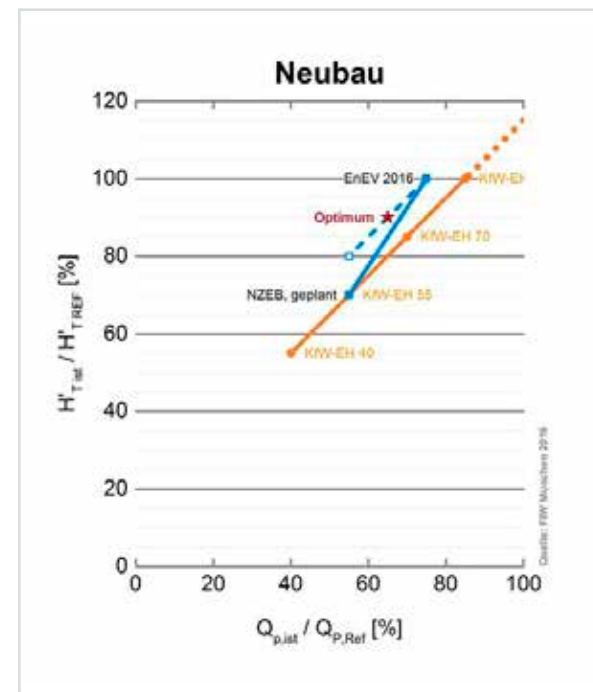
ce possible consequences for future requirements for the building standard and on design of the framework conditions.

The results of the study show that the energy savings on the basis of "Effizienzhaus 55" are not sufficient to outweigh the required additional costs. This means that implementation of the planned standards is not economically viable for building contractors without additional funding as this is currently possible via the KfW-Bank. Further reduction of transmission heat losses and primary energy need requires a more elaborate and costlier building shell and supply technology. Comprehensive inclusion of renewable energies will be absolutely necessary to be able to meet future primary energy parameters; this will have sustainable changing effect on the supply systems: heat pumps, solar heating and ventilation heat recovery increase efficiency, but also make building more expensive. Proven standard technologies (such as condensing boilers) will not be able to meet future limit values without additional measures (e.g. support by solar heating, ventilation heat recovery, bio-gas, improved building shell), correspondingly resulting in relevant additional costs. By contrast, moderate increase of the energetic requirements for the building shell, e.g. to approx. 90% of the currently permissible values, can be implemented without significant additional costs regarding the shell. Economic "optimum" without considerable additional costs will be achieved with only a slight increase in the thermal characteristics of the building shell using  $H'_{T, actual} / H'_{T, REF} = 90\%$ . Any further increase would be connected to a significant increase in costs. Regarding the objectives on primary energy need, also stricter requirements that are significantly above the economic optimum at approx.  $Q_{p, actual} / Q_{p, REF} = 65\%$  would be possible. Calculations show that the customary technologies on the market allow for significant undershooting of the primary energy requirements within scope of almost identical costs.

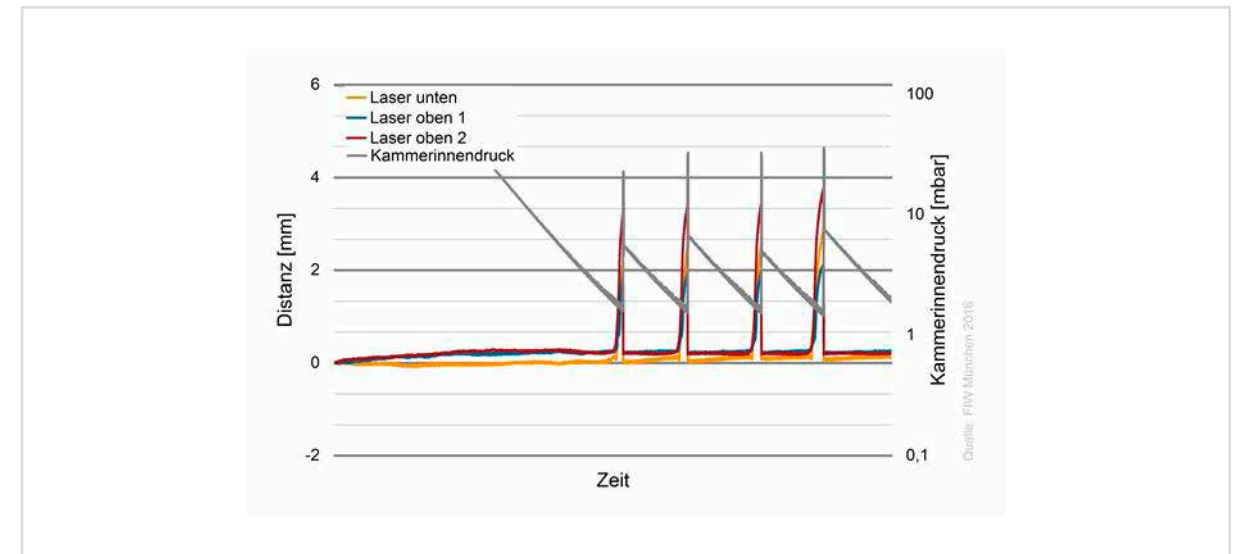
**Examinations on the impact of boundary conditions when measuring the interior pressure of vacuum insulation panels by means of film lifting method**

Susanne Regauer, Sebastian Treml

The interior pressure of vacuum insulation panels (VIP) is decisive for the low thermal conductivity of these insulation materials and correspondingly represents an important measure for assessment of panel quality. Measurement of interior pressure is used for quality control after production, for determination of annual pressure increase rates as basis for determination of nominal values of thermal conductivity as well as for scientific purposes in the field of ageing processes in various constructional applications such as testing of new barrier films or optimisation of production processes.



† EnEV 2016 and KfW development standards depending on the requirements for the building shell ( $H'_T$ ) and the primary energy need ( $Q_p$ ). An almost cost-neutral increase of the legal requirements is given at the "optimum" of  $H'_{T, actual} / H'_{T, REF} = 90\%$  and  $Q_{p, actual} / Q_{p, REF} = 65\%$ .



† Barrier film lifting process in mm and interior pressure in chamber in mbar as a function of time during determination of interior pressure with a VIP with 10mm

Direct determination of the interior pressure of VIP by using corresponding pressure transmitters is only possible with particularly manufactured VIPs. Thus, often the so-called film lifting method is used for determination of the interior pressure.

For this, the VIP is positioned within a vacuum chamber and the pressure in the chamber is lowered continuously by using suitable vacuum pumps. During the evacuation process the interior pressure in the chamber is recorded, and the movement of the surface of the VIP's barrier film is monitored with a laser distance sensor using the same clock rate. If the interior pressure in the chamber is below the interior pressure of the VIP, the barrier film will lift from the core and this will be detected by the laser distance sensors. Suitable evaluation methods can be used to calculate the interior pressure of the VIP on the basis of the functional relation of translation of the monitored point on the film and the recorded interior pressure in the chamber.

Currently, there is no standard for determination of the interior pressure using the film lifting method. Implementation in practice shows various impacts depending on the formats of the tested VIP (surface, thickness, geometry), the employed barrier films and the bulk density of the core

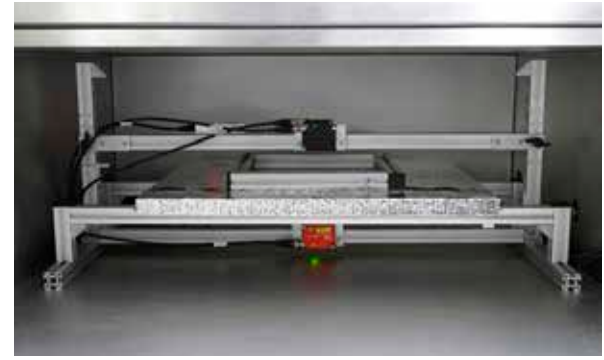
material, which may affect the result or impede evaluation of the determined raw data. A project funded by Vacuum Insulation Panel Association (VIPA international) examined the impact that supporting the VIP within the chamber as well as the number and positioning of the laser distance sensors for monitoring the movement of the barrier film, and the control of the interior pressure in the chamber with regard to pressure drop rate and intermediate ventilation will have on the variation of the results of determination of interior pressure with a multitude of VIPs with various barrier films, thicknesses and formats.

The project revealed that clamping the panel within a squarely limited measurement surface and monitoring of film surface using three laser distance sensors are the most suitable combination. Monitoring the film surface from above and below allows for computational elimination of any possible sagging of the panel during measurement and increases failure safety in case of falsified path data due to formation of creases in the barrier film. The graph shows the measurement data for determination of the interior pressure using the optimised measurement design. It can be seen that the lifting processes of the barrier films are uniform above and below.

**Consideration of thermal bridge effect of chimneys in residential buildings**

Holger Simon

The current Energy Savings Ordinance does not require any consideration of the chimney as punctual heat transition coefficient ( $\chi$ -value) in any certificate under public law. To also highlight this with regard to standards, the revised version of DIN 4108 Bbl 2 explicitly should include the sentence that fireplaces (chimneys) are not further considered in the thermal bridge certificate due to their complex method of action. However, if the thermal bridge effect of chimney systems is to be determined, e.g. when comparing various systems of when planning buildings within boundary conditions under private law, it will be reasonable to consider the chimney being a punctual thermal bridge penetrating the roof skin. In such case, consideration of the length-related heat transition coefficients



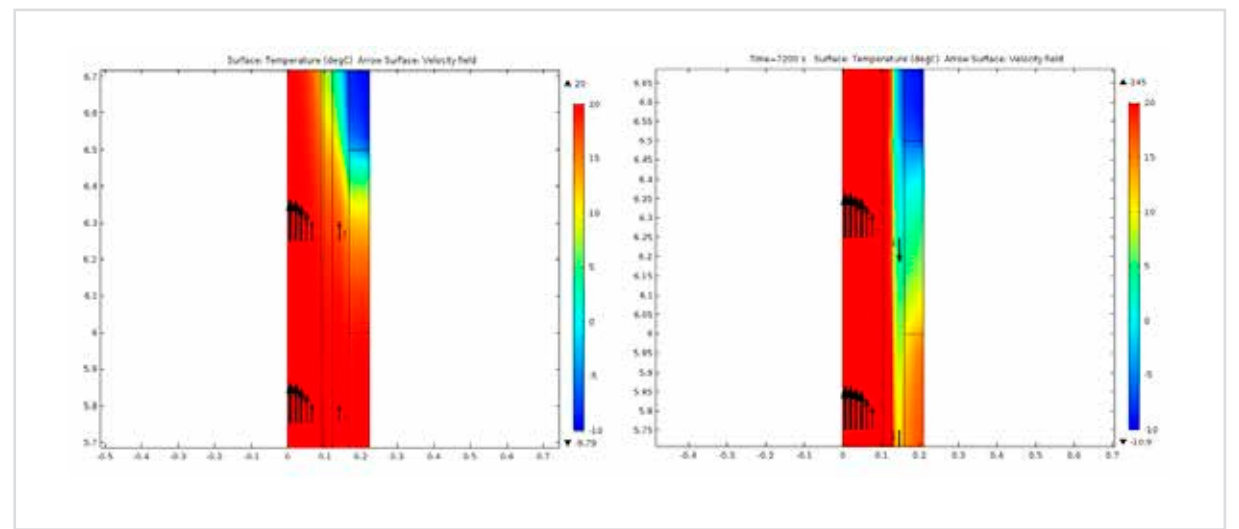
† Support situation and arrangement of laser distance sensors for measurement of interior pressure of VIPs using the film-lifting method in the vacuum chamber

( $\psi$ -value), e.g. based on the circumference or height of a chimney, will not be necessary as any impacts are already included yet in the punctual thermal transition coefficient.

In view of the above, FIW München undertakes the “Calculations on thermal bridge effect of exhaust systems” research project on behalf of numerous chimney manufacturers. The large-scale examination is based on the approach to differentiate between operation and standstill of the fire system, already developed in 2014.

In the first case – the fireplace in in operation – the hot exhaust gas goes upward in the flue pipe, and the combustion air and/or the cold external air is transported downward to the fire via the air duct, if present. In the second case – the fireplace is in standstill – low amounts of room air may get into the chimney via leaks in the chimney system and/or the connectors. In both cases, the temperatures within the exhaust pipe do not correspond to the temperature of the external air; this also applies to the air duct, depending on its position (concentric, adjacent), on its further path. The temperatures within the flue pipe and the air duct are significantly above the temperatures of the external air. Correspondingly, the heat flow from the room into the chimney does not correspond to the heat flow based on the simplified approach using the temperature of external air in the exhaust pipe and/or the air duct. The actual heat flow – along the height of the chimney – can be directed from the room into the chimney or from the chimney into the room. This depends on various parameters, e.g. the distance to the fireplace or the heating curve and/or the operating and standstill times. The same applies to the temperature of the room side on the surface of the casing block. This temperature also does not correspond to the temperature from the simplified approach and also depends on the distance to the fireplace and/or on the intersection with the roof as well as on the heating curve.

That is why further methods, which better reflect the actual conditions at the chimney, are proposed here. For this, the flows of flue gas and combustion air and/or of infiltration air are considered during operation and/or standstill of the chimney. As the heat transfer by the slowing gases depends on the length and/or height of the chimney, a reference height of 9.50 m is set, with the chimney protruding the roof by 1.00 m. The heat flow, the  $\chi$ -value and the temperature on the room side are determined up to a distance of 1.00 m below the roof. The model size corresponds to DIN EN ISO 10211 and should make sure that the thermal bridge in the area close to the roof is considered and that any further, spatially distant impacts on behalf of the fireplace are ignored, particularly if it is planned to deviate from the reference height of the chimney and, in the individual case, a concrete installation situation is to be reproduced. The results of the calculation for operation and standstill of the fireplace are weighted on a time



basis. Weighting is made on the basis of a simplified heating curve adapted to the corresponding heating system.

The proposed method offers the benefit that it better reflects the actual conditions at the chimney both regarding operation and standstill as compared to the simplified approach. Setting a reference height of 9.50 m enables comparability of different chimney systems. Assessment of the calculation results is made expediently for the upper metre below the roof and provides comparable  $\chi$  and surface temperatures for the chimney. This method does not require additional consideration of the  $\psi$ -value as the heat flow from the room via the chimney to the external air and the interaction between the chimney and the roof are included already in the punctual heat transition coefficient ( $\chi$ -value). If the thermal bridge effect of the chimney is to be stated within scope of planning of a building, it is recommended using the  $\chi$ -value as per the method presented here and to use a  $\psi$ -value of zero.

- † Presentation of flows and temperatures within the chimney. Both images on the left show the flue pipe, followed by an insulation layer, the concentric air gap and the casing block.
- † Left image: the fireplace is on standstill. Hot infiltration air goes upward and heats up the chimney. In the region of the roof penetration, the air and the chimney cool down.
- † Right image: two hours after change from standstill to operation. The suctioned cold combustion air cools the casing block of the chimney. (The temperature of the flue gas is significantly above 20 °C, but scaling was capped here to be able to better represent the temperature of the casing stone.)



### Improvement of emission measurement with reflecting insulation materials

Holger Simon

Knowing the thermal emissivity is a decisive parameter for modelling the heat transition coefficient between two surfaces. Modelling of the radiation heat flow makes it necessary to know the “whole hemispheric thermal emissivity”, i.e. the emission level as integral over all wavelengths and all directions.

However, a current comparison of measurement techniques performed within scope of the work of CEN / TC 89 / WG 12, showed high discrepancies (emission level of 0.02 to 0.08 with the same product). The causes for the deviations have not been established yet; presumably, the geometric, thermal and optic configurations of the instruments play a role. As it could not be shown that the measurement technologies for determination of the thermal emissivity are reliable if the emission level is less than 0.05, CEN / TC 89 / WG 12 defined the limitations in the CEN standard EN 16012, stating that each measured value of the emission level that is lower than 0.05 should be rounded up to 0.05. However, such limitation represents an obstacle for product development and market innovation because a manufacturer cannot declare products with an emission level below 0.05.

That is why FIW München is involved in a European research association composed of national metrological institutes, research institutes, universities and manufacturers to enable – jointly with the 11 project partners from a total of 6 states – reproducible and transparent measurement of low values of the thermal emissivity of external surfaces of reflecting insulation material and, correspondingly, to respond to the requirements for CEN / TC 89 / WG 12.

The technologies of calibration and measurement should be improved to such an extent that the deviation in case of an emission level of less than 0.1 is not more than 0.03 when employing different measuring techniques.

The European research project has a duration of three years (June 2016 until May 2020).

### Pressure behaviour of vacuum panels according to EN 826

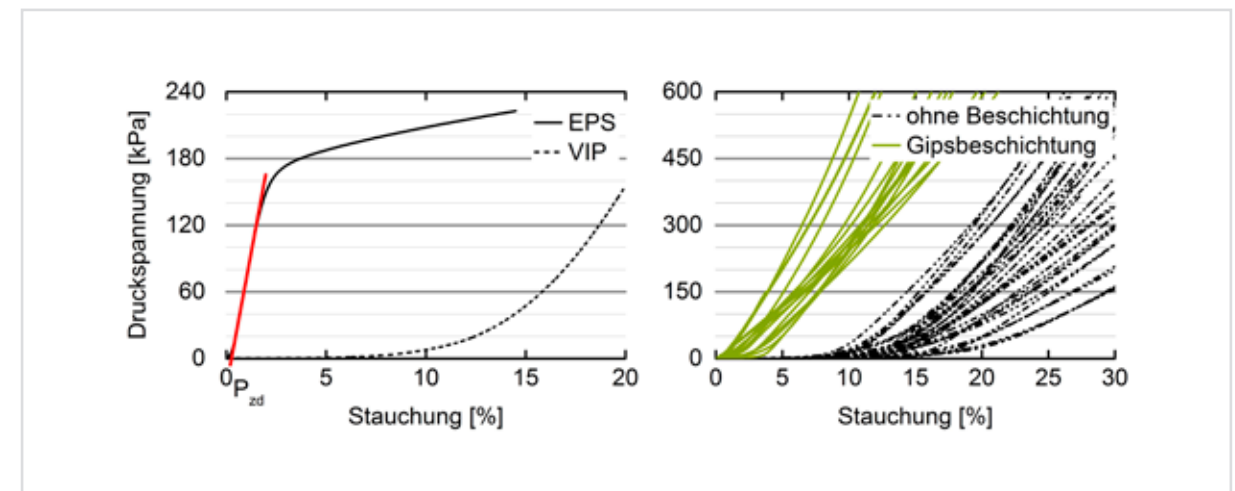
Gerald Coy

Measurement of pressure behaviour of vacuum panels according to EN 826 provides a test result that is hard to assess objectively and according to the standard. Interpretation of the results requires a lot of experience and well-trained laboratory staff – this cannot be granted everywhere. The objective of the study is to make the results of pressure behaviour comparable and reproducible, which requires thorough examination and adaptation of the test process.

Compared to customary insulation materials such as EPS, XPS, etc., the stress-compression diagram of vacuum panels does not include a linear region and correspondingly no elastic deformation. In such case, the standard provides that the deformation at a load of  $250 \text{ Pa} \pm 10$  is to be defined as zero point of deformation, from which compression is to be measured. Regarding vacuum panels, this results in a very low value for compression stress at 10% compression due to the long starting portion in the stress-compression diagram.

Amongst others, the long starting region and the non-linear behaviour are due to manufacturing-related properties such as welding seams and slight bowl-formation of the panels due to the vacuum creation process as well as the fact that a vacuum panel represents an inhomogeneous insulation material so that various pressure behaviour overlap each other. First results showed that it is not possible to achieve a linear pressure behaviour by adapting the test method. Thus, the focus was on shortening the starting portion in the stress-compression diagram, which only will be possible if the impact of the welding seams as well as the bowl formation can be reduced. If such irregularities or disturbing locations at the test body cannot be removed by mechanical processing, the EN 826 standard requires that the test body is to be provided with a suitable coating.

A gypsum coating offers a lot of benefits – very good processability, low price, proper viscosity at processing to



compensate for all irregularities, and this material is not compressible when hardened. Moreover, gypsum is stated already in EN 826, correspondingly simplifying the implementation of such test method according to the standard.

When coating the test body with gypsum, the starting portion in the stress-compression diagram was shortened significantly. This results in higher compression stress values at 10% compression. Furthermore, distribution of the curves is significantly lower, indicating a better reproducibility of the results.

The pressure behaviour of the vacuum panel itself can be seen more distinctly and it can be differentiated amongst manufacturers, which was not possible before in connection with the impact imposed by welding seam and bowl formation. Technical evaluation of the pressure curve by the laboratory staff for determination of the zero point of deformation is not necessary anymore because the zero point of deformation and thus also the region for the 10% compression are fixed by the test.

† Figure on the left: comparison of pressure behaviour of EPS and vacuum panel in 10mm and silica core. Vacuum panel with long starting portion and non-linear behaviour. Determination of a zero point of deformation  $P_{zd}$  is not possible.

† Right: comparison of pressure behaviour of 10mm vacuum panel with gypsum coating and without coating. Significantly shorter starting portions and correspondingly higher pressure values at 10% compression. The lower distribution of the group of curves indicates better reproducibility of the results; pre-load 250Pa.

## FIW certification body

DIN EN ISO/IEC 17065 “Conformity assessment - Requirements for bodies certifying products, processes and services” represents the qualitative basis for the work of the FIW certification body.

Certification by the Deutsche Akkreditierungsstelle DAkkS includes voluntary certification programmes for thermal insulation materials as well as certification of sealing webs and thermal insulation materials within scope of the Construction Products Regulation. Quality management of the FIW certification body verified within scope of the annual audits performed by DAkkS. Here, focus is on

independence of the certification body, neutrality of certification decisions, implementation of all standard requirements, and qualification of staff members.

According to DIN EN ISO/IEC 17065 the overall objective of certification of products is to give confidence to all parties involved on that a product meets predefined requirements. The value of certification is the degree of confidence given by means of an independent and competent proof on compliance with specified requirements furnished by a third party.

## FIW test facility with internal calibration laboratory

The re-certification of FIW test facility was made in September 2016. In a two-day audit, three expert auditors and the system auditor of the Deutsche Akkreditierungsstelle DAkkS verified implementation of the requirements of DIN EN ISO/IEC 17025 by the quality management for the FIW test facility. The focus of the audit was on competence of staff members, calibration of testing means, performance

of tests according to the standards as well as the described work processes. After receipt of the new certification document, extension as “notified body” will be applied for at the DIBt. This allows for further test activity for our customers within scope of CE marking.

## Measurement uncertainty – an important element of quality assurance

*Scientific knowledge is a body of statements of varying degree of certainty – some most unsure, some nearly sure, but none absolutely certain.* R. P. Feynman

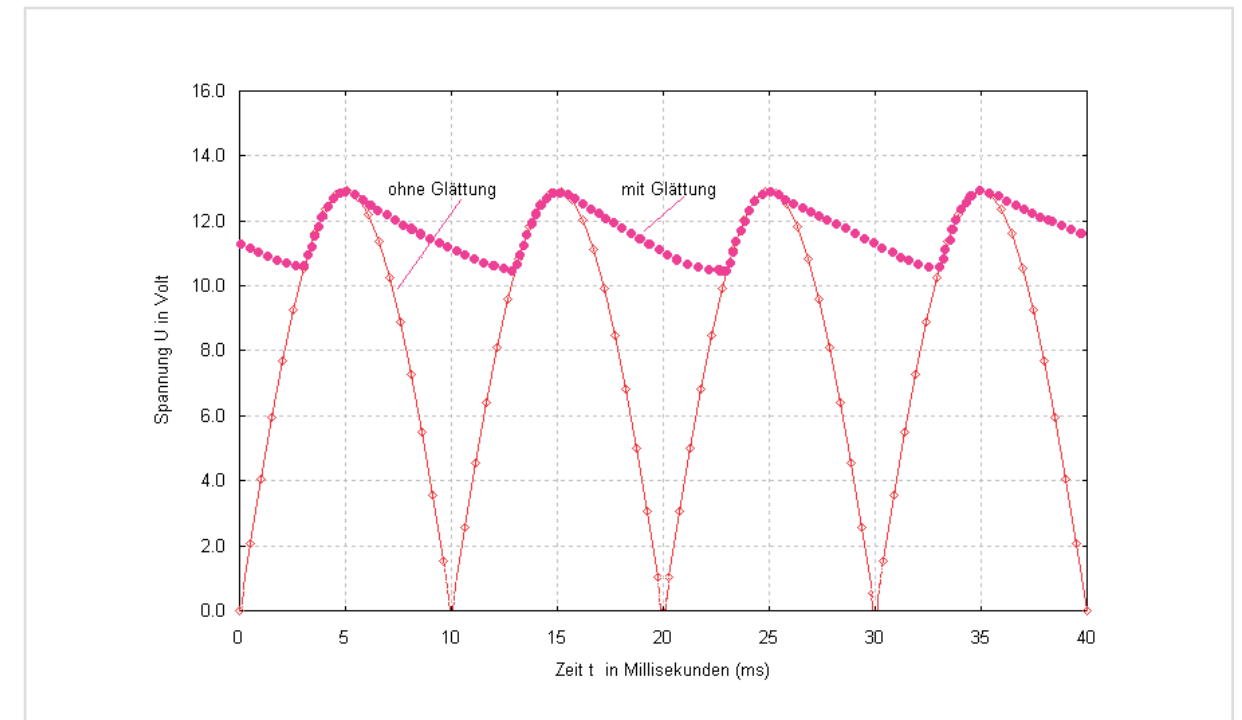
It is in the nature of a measurement that it cannot have any certainty. Thus, it will not be a matter of misbehaviour or wrong measurement if a result deviates from the “true value”: measurement uncertainty does not express the worry to be uncertain when measuring – measurement uncertainty provides security with regard to the measurement result.

Any measurement value has an uncertainty.

Such deviation results from the following:

- random effects such as short-term fluctuations of temperature, air humidity, air pressure, performance of the observer
- systematic effects such as deviation of measuring instruments, calibration normals or reference material

The measurement uncertainty represents the width of distribution of the measurement deviations. The lower the measurement uncertainty, the more reliable the result of a measurement. That is why knowing the measurement uncertainty and its determination have a high impact in practice.



† DC voltage with and without filtering at output of the bridge rectifier

FIW München employs the GUM (Guide to the expression of uncertainty in measurement) for calculating the measurement uncertainty; this is an international guideline that established itself as a standard.

The consistent further development in construction of instruments as well as the use of highly accurate state-of-the-art measurement and calibration technology enables FIW München to continuously improve measurement uncertainty. This continuous improvement can be proven by means of an example from practice:

electrical power is a decisive factor when measuring the thermal conductivity. Such power is generated with DC power supply units and calculated by measuring voltage and current ( $P=U \times I$ ).

Despite filtering, each DC power supply unit has a residual ripple. Thus, FIW only uses linearly controlled power supply units with lowest possible residual ripple.

Nevertheless, even such low residual ripple represents an influencing factor on the measurement uncertainty when measuring thermal conductivity in connection with linearly controlled power supply units.

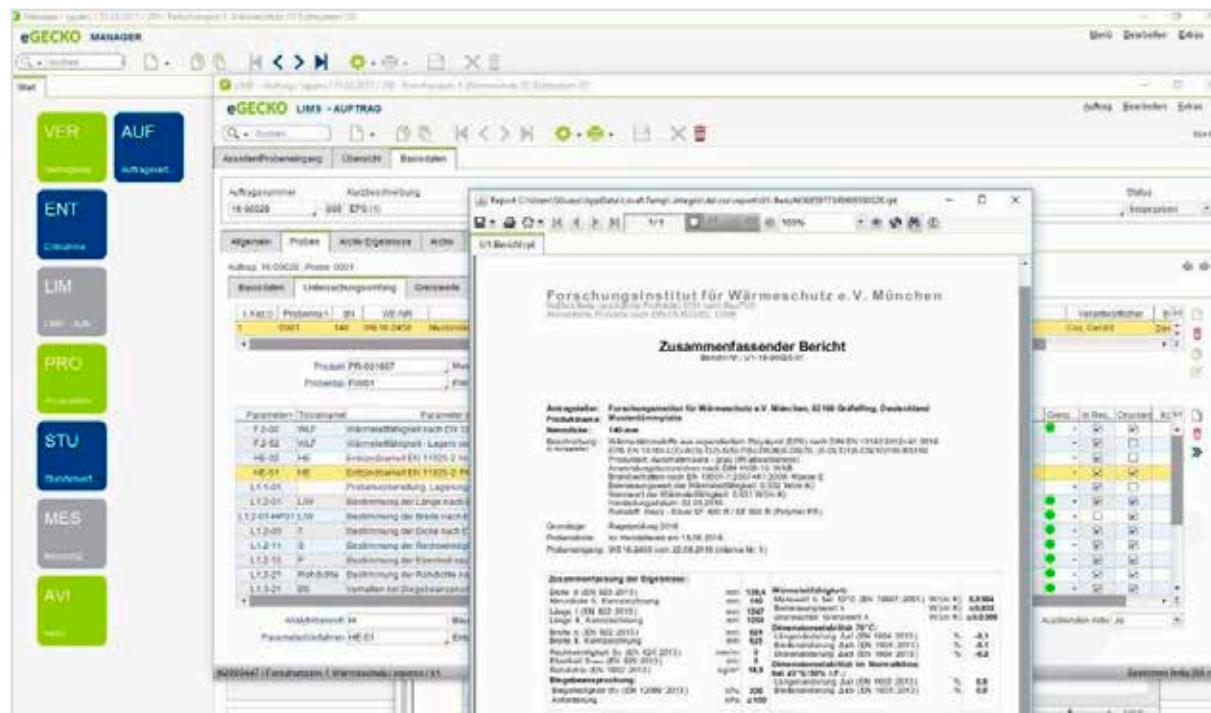
In the future, the residual ripple should be measured and averaged by using corresponding measurement technology and high-frequency scanning of the measurement signals. Thus, the impact of residual ripple on the measurement uncertainty will be minimised.



† Internal research project; prototype/test design for the next generation of instruments



## Implementation of ERP and LIMS software



In the past years, we already reported on the introduction of the company-wide “all-in-one software”; such project is now on the home stretch.

Adaptations and developments in the field of CRM (Customer Relationship Management), invoicing and financial accounting are complete.

Work in the last, largest and also most important field of the system also is close to completion. The field of LIMS (Laboratory Information and Management system) and contract management reflect the products of FIW: the test report as well as the certificate.

Every change also offers the possibility to include and implement the customers’ wishes and requests without being forced to abandon proven matters. In our version, LIMS includes product maintenance of customer products, order processing and finally the creation of reports by means of a test report or certificate.

Here, also automated recording of measurement data and transfer are maintained as proven methods and are further extended. Currently, not all laboratories having such connection in the old system are included. Instead, other – formerly single – areas were integrated into automated transmission of measurement data.

The new system certainly offers visible changes for you as our customer. The reports generated from the measurement data are and will be reviewed and updated to the latest version, and their design will be unified. We still adhere to the one-sidedness appreciated by our customers. And who knows – maybe you already had a new report in your hands and were pleased that FIW still stands for bringing state-of-the-art measurement values to paper with the highest possible certainty.





## 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 of testing, surveillance and certification bodies, foamed plastics and wood wool  
*W. Albrecht*

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

- Technical committee (TA)  
*R. Schreiner*

### IVH (Industrieverband Hartschaum e. V.)

- 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 (chairwoman)*
- Expert committee "Energy use"  
*K. Wiesemeyer*
- VDI-Gesellschaft Energie und Umwelt (VDI-GEU) division 3  
*R. Schreiner, K. Wiesemeyer*

### 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 light-weight panel  
*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 for heat transmission. Rated values of thermal conductivity (DIN V 4108-4) and minimum requirements for thermal insulation materials (DIN 4108-10)  
*W. Albrecht (chairman)*
- NA 005-56-93 AA Airtightness (SpA ISO/TC 163/SC1/WG10)  
*Dr-Ing. S. Tremel*
- NA 005-56-97 AA Transparent components (SpA 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. Tremel*
- NA 005-02-91 AA Flexible underlays for discontinuous roofing and walls (Sp CEN/TC 254/WG 9)  
*Dr-Ing. S. Tremel*
- NA 005-02-92 AA Rigid underlays for discontinuous roofing (Sp CEN/TC 128/SC 9/WG 5)  
*Dr-Ing. S. Tremel*

## 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*

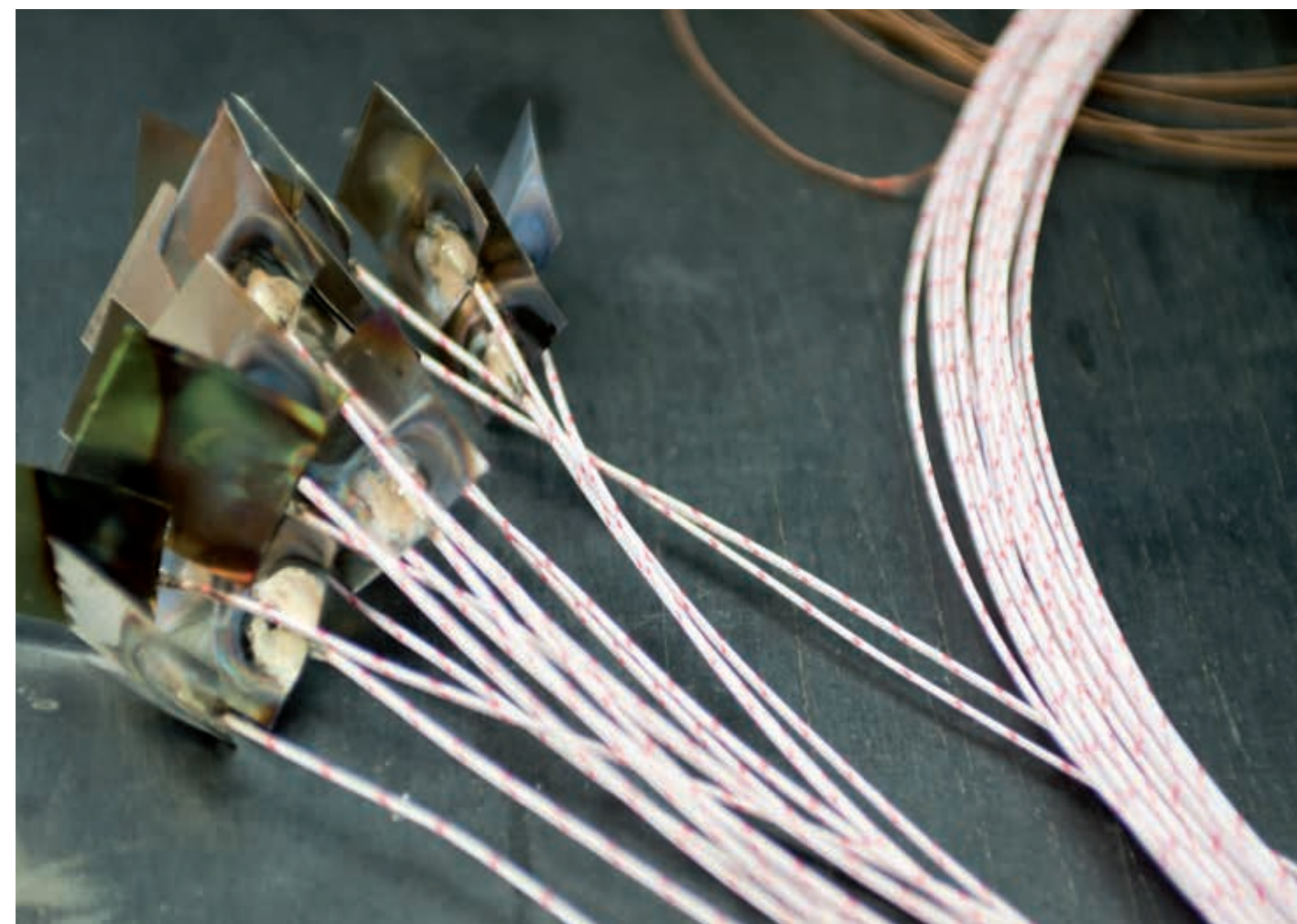
### CEN (Comité Européen de Normalisation)

- 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 Glas (CG)  
*S. Sieber*
- TC 88/WG 9 Woodwool (WW)  
*S. Sieber*
- TC 88/WG 10 Building equipment and industrial installation  
*R. Schreiner (Convenor)*
- Liaison officer with CEN/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)  
*C. Sprengard*
- TC 88/WG 12 Expanded Perlite Boards  
*W. Albrecht*
- TC 88/WG 16 Evaluation of Conformity  
*R. Gellert*
- 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  
*R. Schreiner*
- TC 89/WG 11 Thermal performance of buildings and building equipment – Task group 1  
*R. Schreiner*
- TC 89/WG 12 Reflective Insulation Materials  
*R. Schreiner*
- TC 107/WG 10 Flexible pipe systems for district heating  
*R. Schreiner*
- TC 254 Flexible sheets for waterproofing  
*Dr-Ing. S. Tremel*
- TC 254/WG 9 Underlays for discontinuous roof coverings  
*Dr-Ing. S. Tremel (Convenor)*
- TC 254/TG WG 9 and 10 Artificial Ageing  
*Dr-Ing. S. Tremel (Convenor)*
- TC 371 Project Committee on Energy Performance of Buildings
- Notified Bodies-CPD/SG 19 Thermal Insulation Products  
*W. Albrecht, R. Schreiner*

### CEN Certification

- SDG 5 Thermal Insulation Products TG  $\lambda$  - 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/SC 3/WG 5 Vacuum-Isolation-Panels (VIP)  
*C. Sprengard*

### 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*

### Other committees

- Fachverband Innendämmung FV ID  
*C. Sprengard*
- Vacuum-Insulation-Panels international Association – VIPA  
*C. Sprengard*
- International Vacuum-Insulation-Panels Symposium – Scientific Committee  
*C. Sprengard*





**German Thermal Insulation Day – for the first time in Berlin**

In 2016, the location of the regular German Thermal Insulation Day of the Forschungsinstitut für Wärmeschutz e. V. Munich (FIW München) was changed to Berlin. This was the first time that the Thermal Insulation Day, which only took place in Munich up to now, was celebrated on the EUREF Campus in Berlin. Located in the Schöneberg district, the EUREF AG has been developing the five hectare-sized campus into an intelligent city for working, researching, educating and living since 2007 – a place of the future, where energetically optimised buildings, a local “micro smart grid” as well as low operating costs thanks to the use of renewable energies are in the focus of development. The property’s focus is primarily on the infrastructure. The supply concept is based on the basic idea to use urban technologies for generation of the required ener-

gy in a manner that is as CO2-neutral as possible and to use such energy efficiently. Already since 2014, the campus has been meeting the 2050 climate goals of the Federal government.

Approx. 100 participants from business, industry, research and government accepted the invitation of FIW München for a joint discussion of the topic of “Energy-related and climate-related requirements for the building sector”. Deutsche Energie-Agentur GmbH (dena), the Technische Universität Berlin (TU-Berlin), the Hauptverband der Deutschen Bauindustrie e. V., the Gesellschaft für Rationelle Energieverwendung e. V. (GRE) and Qualitätsgedämmt e. V. were introduced as new cooperation partners of this year’s Thermal Insulation Day.

Klaus-W. Körner, chairman of FIW München, opened the Thermal Insulation Day with a keynote. On that occasi-

on, Klaus-W. Körner said that “currently there is light and shadow.” There is light because the Paris Climate Change Conference sent a strong signal. Given the fact that both the USA and China will ratify the Climate Action Plan 2050, there is also great hope. “The first hurdle has been taken. Now it will be important to powerfully implement this powerful signal from Paris so that the Climate Action Plan 2050 becomes binding for all people”, Klaus-W. Körner said. “Social justice and ecological sustainability will only work hand in hand. Mere memoranda of understanding will not be sufficient anymore; the previous symbol politics must come to an end.” Regarding the stated objective of a refurbishment rate of two percent in the field of building, Klaus-W. Körner stated even more shadow. “It should be clear to anyone that the focus absolutely is on the building sector. Currently, we are experiencing a refurbishment rate of less than one percent. This situation needs a change. Carbon-neutral construction will result in econo-

mically friendly living. The shift from the power change to the energy change can only be achieved by giving a higher priority to structural heat insulation.”

Andreas Kuhlmann, chairman of the dena management, said that energy efficiency currently is the most important innovation driver. He said: “We need to save more energy, and the building sector is the centre of all actions.” Andreas Kuhlmann said that he is not quite content with regard to the Climate Action Plan 2050. “Today we need more than just ratifying a contract. We need a new debate on energy efficiency in politics – we need a change of paradigm.” The dena CEO asked for more commitment in politics. “I think there are too much sweeping statements, but too few actions.”

The two opening statements were followed by ten expert presentations. Prof. Dr Dr h.c. Hans Joachim Schellnhu-





ber, Founding Director of the Potsdam Institute for Climate Impact Research e. V. (PIK), was a particular guest of honour amongst the experts. Schellhuber is one of the most renowned climate researcher all over the world and received several prestigious awards for his work, amongst others the title of “Commander of the Most Excellent Order of the British Empire (CBE)”, which was granted by Queen Elisabeth II. Amongst others, he is counsellor of the World Bank, the German Federal Government and the Holy See. In 2015, Pope Francis made him full lifetime member of the Pontifical Academy of Sciences. For three decades, Schellhuber has been researching the climate change as a problem of the human race. Being the founder of the PIK, which he has been heading until today, he published hundreds of scientific papers and established ideas such as the two-degree objective of global warming, which is internationally recognised today. Schellhuber posed urgent warnings in this presentation: “Actually, humanity is on its path to the undesired self-combustion unless it will turn to the path of sustainability very soon. If



we continue to burn unreduced amounts of coal, oil and gas, the correspondingly emitted greenhouse gases will heat up our planet by approx. four degrees until the end of the present century, and by six or eight degrees later on. 2015 already was recorded in the history books as the hottest years since the start of measurement – this crisis is abundantly clear”, said Schellhuber. “Extreme weather events will result in risks of unknown extent – from the increase of the sea levels to large amounts of climate refugees.” Schellhuber did not only refer to himself as being a scientist, but also as being a “conscientist”: “I feel myself responsible to not only share our knowledge with other researches, but with all people that finally will be affected by the consequences of the climate change and who will be able to stop the climate change.”

The discussion session on “The power of the media” was another highlight. The author Ulrich Wickert and the DER SPIEGEL [newsmagazine] editor Jan Fleischhauer interviewed each other. This created an entertaining 30-minute



te analysis of two intellectuals of the German media landscape. Right in the beginning, Ulrich Wickert dispelled the myth that the media have too much power. “Media will not be able e.g. to decide elections. That's nonsense. They might be able to have an impact on the moods in the run-up. But nothing more.” Ulrich Wickert, who is a former Tagesthemen [German news show] presenter, also commented on the new role of some journalists in the refugee crisis. “Suddenly, journalists are not only observers, but also activists for a cause. I'm not sure if such development is good. In general, journalists should stand up for values, but they should not actively participate in a cause”. Jan Fleischhauer made an even more distinct statement: “We reward the wrong things. Dunja Hayali gets the “Goldene Kamera” award because of her attitude during a Pegida [right wing civil movement] march. An award for attitude! Everything all right?” The real reason for the award was the shit storm after such event, said the Jan Fleischhauer. Ulrich Wickert agreed and added: “Often, I think that journalists are too weepy. They also make mistakes, and they

are allowed to do mistakes.” Ulrich Wickert said that the situation of the press in Germany is good in general: “The German media are amongst the best media in the world. 80 percent of the Germans trust them.”

The German Thermal Insulation Day 2016 was concluded by the summary and the outlooks stated by Prof. Dr-Ing. Andreas H. Holm, Institute Manager at FIW München. Andreas Holm's motto: “Now, we must think of the future!” Andreas Holm invited the audience to a journey through time, showing 40 years of energy efficiency in buildings. On July 1976, the Federal Republic of Germany adopted an Energy Savings Act (EnEG). Andreas Holm showed examples for the development of the requirements during the past decades – from the energy-saving heat insulation (WSchV) to energy savings with buildings (EnEV) and EE-WärmeG. Andreas Holm also stated that the combination of the three elements of energy saving, increase of energy efficiency and use of renewable energies is absolutely necessary for successful building.

The next Thermal Insulation Day of FIW München will be in Berlin on 19/20 June 2017.

For further information, please refer to:  
[www.waermeschutztag.de](http://www.waermeschutztag.de)

## Basic principles

On 22 June, the staff of FIW München presented current results at the Haus der Bayerischen Wirtschaft. There was a multitude of topics ranging from fundamental research for determination of the emissivity to synopsis of calculation methods for heat insulation and aspects of state-of-the-art high-performance insulation materials to assurance of the quality of insulation materials.



**Determination of emissivity of surfaces by means of measurements with the two-plate device**  
Roland Schreiner

Presentation of an alternative method for determination of emissivities of technical surfaces. The benefit of this test method is that it uses larger test bodies as compared to the conventional optical methods. First tests could confirm the usability of the measurement principle. Consequent further development of the measurement method as well as minimisation of measurement uncertainties will further qualify the method for determination of the emissivity using the two-plate device.



**Comparison of heat insulation calculation methods according to VDI 2055, EN ISO 12241 and ASTM C 680**  
Karin Wiesemeyer

There are several calculation methods for determination of the heat losses of operational systems. The presentation deals with the question whether the calculation standards will show identical or different results. The differences will be dealt with in theory first, and then they will be shown in two examples.

The biggest difference is in the calculation of the external heat transition coefficient. Such coefficient highly affects the surface temperature. Due to the difference in the standards, a planner or system builder always should base the calculation on the requested standard as there could be great differences when e.g. basing the calculation on the surface temperature.



**Impact of moisture on technical insulation systems**  
Robert Hofmockel

Although being well researched and understood, moisture still represents a serious problem in the industry. Water may get into the insulation system via openings or by means of diffusion; in the system it will lead to problems such as worsening of thermal conductivity, increased weight of insulation structure or corrosion below the insulation. The corresponding damage is considerable and can be limited when employing suitable measures.



**Measurement of specific thermal capacity in thermal conductivity plate apparatus**  
Roxana Künzel

The presented measuring method offers a new possibility for measurement of the specific thermal capacity of insulation materials on whole plates. Measurements can be performed with conventional measuring plate apparatuses and can be evaluation by employing a simple method. Limitations of such methods are discussed with the help of exemplary measurements performed with XPS, mineral wool and wood fibre insulation plates.



## High-performance insulation materials



**Vacuum insulation panels for construction use: comparative method for artificial ageing with various relative humidities and temperatures – projection on service life in various surroundings**  
Dr.-Ing. Sebastian Tremel

In dem Vortrag werden Alterungsuntersuchungen an Vakuumisulationspaneelen vorgestellt. Auf Basis einer künstlichen Alterung durch Lagerung bei unterschiedlichen Temperatur- und Feuchtebedingungen werden in Kombination mit hygrothermischen Simulationen für exemplarische Anwendungsfälle Modelle für die Entwicklung des Druckanstiegs in den Paneelen als Funktion der Nutzungsdauer entwickelt. Die vorgestellten Ergebnisse sind ein Beitrag zur Entwicklung geeigneter Methoden zur künstlichen Alterung von Vakuumisulationspaneelen sowie zur Ableitung sinnvoller Bemessungswerte der Wärmeleitfähigkeit über die angestrebte Nutzungsdauer.



**IEA Annex 65: round robins for high-performance insulation materials and first results**  
Christine Maderspacher

The Annex 65 titled “Long-Term Performance of Super-Insulating Materials in Building Components & Systems” is one out of many research projects of the International Energy Agency (IEA). 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. 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 ageing methods as well as the development of appropriate testing and calculation methods by analysing their area of application under boundary conditions.

For such purpose, a large round robin was started within scope of the present research project for testing various vacuum insulation panels (VIP) and aerogel insulation materials at a total of 22 participating testing laboratories and research institutes. In order to assess the long-term behaviour of the thermal conductivity of the products, the tests are repeated after several ageing steps in the climate storage. The procedure of such round robin as well as first results will be presented at the FIW Research Day.



**Measurement of pressure resistance of vacuum insulation panels**  
Gerald Coy

The pressure behaviour of vacuum panels according to EN 826 significantly differs from the behaviour of customary homogeneous insulation materials. There is a long starting portion in the stress-compression diagram due to irregularities and the presence of film seams. Furthermore, the pressure behaviour does not have a linear portion so that normal determination of the “zero point of deformation” is not possible.

All of the above require a more detailed investigation of the pressure behaviour of vacuum panels as well as the elaboration of new approaches with regard to the test method.



**Barriers for market launch of innovative high-performance insulation materials**  
Christoph Sprengard

Innovative high-performance insulation materials – so-called “superinsulating materials (SIM)” – are materials that differ from the established insulation materials by presence of a significantly lower thermal conductivity. The presentation explains the functioning and the history of the use of such products for insulation in the building industry and in engineering. Bringing such material to the market requires the break-down of several barriers. In parts, these are the same barriers as with the market launch of further developments of customary insulation materials, e.g. technical barriers and barriers under building law as well as considerations regarding economic efficiency and barriers in marketing and distribution, but particularly also questions resulting from the properties and the structure of new materials. For example, measurement and calculation methods that are proven on the long-term may reach their limits when being employed with new materials, or fastening solutions may require a change.



## Heat and moisture protection in practice



**Interior insulation: state of measurements and calculations with materials, systems and large-format components**  
Holger Simon

The presented project deals with increase of energy efficiency by using interior insulation systems and runs from October 2014 until September 2017. This is to present a partial aspect of the research, i.e. the current state of examination of the thermal bridge with interior insulation.

The presentation includes the two main topics of "measurement and subsequent calculation of large-format components" and "correlation between 2-D and 3-D calculations". The first part of the presentation specifically deals with manufacturing and handling of a particularly large test body. The second part uses exemplary 2-D and 3-D calculations to explain the procedure of examination regarding the correlation factors.



**Compartment insulation materials: measurement concept and knowledge regarding function after three winters**  
Max Engelhardt

The presented project is intended to be a classic example for showing the possibilities of component monitoring supported by measurement technology.

In the present case, the measured objects included an exterior wall structure as well as a flat-roof structure in a version that intentionally infringes the codes of practice. Various compartment insulation materials were inserted into the wood frame structure and were compared to each other. The implemented measurement concept can be used to analyse the hygrothermal behaviour of the examined building shell and to assess the fitness for use.



**Economic construction and refurbishment: highly heat-insulating and economic building shells**  
Florian Kagerer

EnEV 2014/2016 and the national implementation of the EU Building Efficiency Directive result in raised requirements for energetic quality of the building shell and on efficiency of energy supply. Based on recent examinations of economic efficiency of energetic measures, the effects of the current development of official regulations on the energetic standard of building shells and supply are presented and analysed.



**Energy efficiency classes of VDI 4610: the example of pipe insulation in EnEV**  
Roland Schreiner

This is to present the classification of technical insulation systems by means of seven energy efficiency classes. The VDI Directive 4610 is used as basic document. The application for pipe insulation in technical equipping of buildings shows a possible further development of EnEV with regard to energy efficiency and consideration of system-related thermal bridges.

## News from standardisation



**Product standard of vacuum insulation panels for use in construction**  
Christoph Sprengard

Since 2001, FIW München has been accompanying vacuum insulation panels for construction during their development from individual demonstration projects to product developments and the first registrations in 2007. This development from an exotic product to a registered and monitored insulation material is succeeded by the next logical step – the elaboration of a product standard. This was initiated with first informal meetings of interested parties in 2011, followed by the establishment of various work groups at CEN and ISO and the official start of the standardisation process in 2013. The presentation presents the individual components of the standard drafts and the further schedule.



**Thermal conductivity: determination of design value on the basis of the nominal value**  
Dr. Andreas Schmeller

According to an ECJ judgement dated 16 October 2014, in addition to the harmonised European standards there must be no national regulations that are contradictory to the harmonised European standards.

Thus, it is necessary to harmonise the German national technical rules for determining the thermal conductivity according to DIN 4108-4 with the definitions of the harmonised European insulation material standards.

For this, data from the work's own production control of a multitude of European and German manufacturers of insulation materials were evaluated in a study. The data should show today's large gap between the design value and the  $\lambda_{90/90}$ -values for insulation materials with  $\lambda_D$ -value that are subject to European regulation.

Based on the current experience, the objective is to establish in a review of DIN 4108-4 a technically correct design value allowance that is also compliant with the harmonised European insulation material standards.

Two presentations deal with the topic of reviewing DIN 4108-4. The part presented by Dr Andreas Schmeller shows the backgrounds and deals with assessment of data.

The subsequent part "The new DIN 4108-4 after the ECJ judgement", presented by Wolfgang Albrecht, then presents the determination of the new design values within scope of the standardisation work.

**The new DIN 4108-4 after the ECJ judgement**  
Wolfgang Albrecht

FIW München and two further material test institutes were asked to sum up today's state of thermal conductivity statistics of the manufacturers of insulation materials and to correspondingly deduce a proposal for the "DIN 4108-4: Design values for thermal insulation calculations" application standard that is compliant with European law.

After the first part presented by Dr Andreas Schmeller, which mainly dealt with the evaluation of data, the next part will deal with the determination of the new design values within scope of standardisation work and "The new DIN 4108-4 after the ECJ judgement".

The main problem was to find an objectively reasonable compromise between the justified interests of the manufacturers and the security level imposed by the German construction supervision agency that has been customary for years.

The manufacturers wanted to proceed in strict accordance with EN 10456. In case of non-hygroscopic insulation materials this would have meant an allowance of 0%, and in case of hygroscopic insulation materials this would have meant an allowance of 2%, deduced on the basis of the previous experience with DIN 4108-4.

When looking for a compromise, it was helpful that some substance groups such as mineral wool, PU and XPS had a customary distance of  $1 \text{ mW}/(\text{m} \times \text{K})$  between  $\lambda_D$  and  $\lambda_{\text{design}}$  value, which was also printed on the label. This was also confirmed by the evaluations performed by Dr Schmeller with regard to most types of insulation material. However, sometimes when it was very hard to reach a desired design value, like with very low heat conductivity levels or in case of thermal insulation materials required to also meet mechanical properties, the manufacturers defined the  $\lambda_{90/90}$ -value to be between  $\lambda_{\text{limit}}$  and  $\lambda_{\text{design}}$  value so that the distance was not 5% anymore.

That is why we had to exhaust the system and had to try to exploit any margin:

the European  $\lambda_D$ -values include the rounding up of the  $\lambda_{90/90}$ -value to the next  $\text{mW}/(\text{m} \times \text{K})$ -level. Depending on the  $\lambda_{90/90}$ -value, this makes up for  $(0.1 - 0.9) \text{ mW}/(\text{m} \times \text{K})$  or, as a percentage, approx. 1.7%. The mean difference between  $\lambda_D$ -value and  $\lambda_{\text{design}}$  value was 4.0% with voluntary, historically related overde-



claration, and 3.2% without overdeclarations.

When adding up these two distances to create a factor of safety, then a value in the region of the old safety level of 5% will be reached.

In case of hygroscopic insulation materials such as wood fibre insulation materials (WF) and wooden wool (WW), also the previous moisture allowance will be added; this results in the old safety level of 7% also for hygroscopic insulation materials.

In case of PU in-situ foam, accompanied by the imperfections at the construction site, and in case of insulation materials, for whom no manufacturers' values were provided, there are special solutions of 10% and/or 20/23%. The following was specified to make the whole process more practicable and easier-to-implement for planners:

<b>non-hygroscopic insulation materials</b>	$\lambda \times 1,03$ but at least $1 \text{ mW}/(\text{m} \times \text{K})$	in the region of $\lambda_D$ : $16-49 \text{ mW}/(\text{m} \times \text{K})$
<b>hygroscopic insulation materials</b>	$\lambda \times 1,05$ but at least $2 \text{ mW}/(\text{m} \times \text{K})$	in the region of $\lambda_D$ : $30-49 \text{ mW}/(\text{m} \times \text{K})$
<b>PU in-situ foam</b>	$\lambda \times 1,10$ but at least $3 \text{ mW}/(\text{m} \times \text{K})$	in the region of $\lambda_D$ : $25-35 \text{ mW}/(\text{m} \times \text{K})$
<b>insulation materials without proofs</b>	$\lambda \times 1,20$ but at least $4 \text{ mW}/(\text{m} \times \text{K})$	in the region of $\lambda_D$ : $20-22^{1)} \text{ mW}/(\text{m} \times \text{K})$
<b>hygroscopic insulation materials without proofs</b>	$\lambda \times 1,23$ but at least $9 \text{ mW}/(\text{m} \times \text{K})$	in the region of $\lambda_D$ : $40^{1)} \text{ mW}/(\text{m} \times \text{K})$

1) Beispiele: dispergierter PU-Schaum und Kork

This created a very simple and easy-to-implement regulation that met with approval with all relevant groups in the standard committee, from the manufacturers to the construction supervision agency.

Labelling will be simplified for manufacturers because only  $\lambda_D$  is to be stated on the label as from 16 October 2016. The planner is responsible for  $\lambda_{\text{design}}$  value (as before). However, it is expected that the manufacturers still will support the planner by pointing to the design value and the conversion method on Internet pages and in printed documents. This regulation represents a good compromise by the standardisation committee as it is objectively justified and does not include rejections with regard to the current practice. That is why it is expected that this is acceptable for all parties involved.

**Schedule:**

The draft has been published on 3 June 2016, and the objection period is until 3 August 2016. The objection meeting will be in September 2016. If there are no fundamental objections, the standard could be present in autumn or at the end of the year. However, the construction supervision agency may also refer to the standard draft in the new administrative regulation on technical construction (VVB).



**Certification and further procedure with insulation materials**  
Claus Karrer

The European Construction Products Regulation requires that national requirements for construction products are defined exclusively by existing European principles, usually by means of harmonised European product standards. The judgement of the European Court of Justice vs. the Federal Republic of Germany dated 16 October 2014 points out this need and requires implementation within a 2-year period. Correspondingly, the building control regulations regarding thermal insulation materials will change significantly as of 16 October 2016. The presentation tries to sum up these changes and to present alternatives for monitoring/certification.

Alle Vorträge nachzulesen unter:  
[www.fiw-forschungstag.de](http://www.fiw-forschungstag.de)



## Workshops

### VDI/KEYMARK product certification “VDI-KEYMARK Voluntary European third party quality mark – product certification”

The workshop took place in Italy on 1 March and on 15 July. The workshop was intended for staff members from the distribution and marketing departments. Presentation included the requirements of VDI/KEYMARK certification as well as the basic principles of CE marking on the basis of a harmonised European standard. Further key aspects of the workshop included the benefits of the voluntary European quality sign as compared to national quality marks, the proof of high quality of insulation material products by a neutral and independent certification body, and the assurance of factory’s own production control.

Contact person: Ralph Alberti

### Thermal Performance of the Exterior Envelopes of Whole Buildings XIII

Clearwater Beach, Florida on December 4–8, 2016  
Session 1 – PRINCIPLES:  
Insulation Performance and Material Properties  
Chairs: Andreas Holm

## Conferences

On 8 September 2016, Roland Schreiner – invited by FESI (Fédération Européenne des Syndicats d’Entreprises d’Isolation) – presented Insulation KEYMARK - *Voluntary Product Certification of thermal insulation products* at the FESI autumn conference in connection with the “Thermal Technical Commission”.



## INSULATION KEYMARK Conference 2016



### European quality assurance of insulation materials without trade barriers

The interest of the insulation material industry was great at the INSULATION KEYMARK Conference 2016 at the DIN in Berlin on 18 and 19. October 2016, which included approx. 85 participants from 15 countries. Experts from the fields of European Commission, certification, manufacturing, test laboratories as well as users impressively presented the importance of the CEN KEYMARK system as a voluntary quality assurance system in general, and also particularly for insulation materials. Since introduction of the KEYMARK certification for insulation materials in buildings in 2002, there has been a lot of change throughout Europe. The goal of the EU Construction Products Regulation newly introduced in 2013 is, amongst others, a uniform regulation on the putting-into-circulation of construction products, their free circulation and the removal of technical trade secrets within the EU economic area. The requirements for substantial properties of the insulation materials as included in the European harmonised product standards cannot be imposed again nationally. The European Commission considers the product quality systems required in some member states as being trade barriers so that such systems increasingly will lose importance in the future. In a free economic area without trade barriers there can be only one European quality assurance such as the KEYMARK system. The EU Construction Products Regulation clearly regulates the framework for stating declared significant properties by the manufacturer using the CE marking. The annual product tests of all declared properties that are not included in the CE marking for insulation materials, correspondingly providing the added value for the end user as and additional marking in addition to the CE marking, as requested by the EU Construction Products Regulation, are an important element of the voluntary KEYMARK certification programme. External monitoring of the declared product performance increases the safety level of the proofs of usability of insulation materials for the corresponding national applications.

The review of the INSULATION KEYMARK certification programme allowed for first-time presentation of a joint certification system for insulation materials in buildings and in technical building equipment as well as for operatio-



onal systems in the industry. Regarding technical insulation materials there is a cooperation between CEN and VDI existing since 2011; thus, the manufacturer may choose between the equivalent VDI / KEYMARK quality marks.

The KEYMARK expert committees elaborate requirements for acknowledgement of registered laboratories that are far beyond the requirements for a certification or a notification. Participation in round robins and performance of audits at the laboratories are the basis for successful registration. The certificates handed over on the second day of the conference confirmed that the registered laboratories hold an extraordinary position as a test laboratory within the certification programme for insulation materials. The EU Commission defined the rules for a free EU economic area, and the KEYMARK system consistently carries on the concept of a European market without trade barriers within the defined framework.

Contact person: Roland Schreiner

## Seminars

The European Industrial Insulation Foundation (EiIF) offers a method for determining the optimisation potential in industrial plants: the TIPCHECK (Technical Insulation Performance Check) has the objective to increase ecological and economic operation.

The TIPCHECK is performed by trained and certified TIPCHECK engineers and includes the following steps:

- evaluation of situation
- analysis
- counselling
- calculation of actions

For this, parts of the system are photographed with a thermal imaging camera, correspondingly providing information on weak spots in the present insulation. Then, detailed analyses are performed as basis for comprehensive counselling, which focuses both on detailed technical actions and cost-relevant aspects. This is because efficient insulation does not only save energy and money and reduces emissions, but it also has a positive effect on process control and safety at the workplace. Also in 2016, EiIF held its TIPCHECK course at the FIW München. The institute does not only provide the premises, but also attends the course when doing practical exercises at the wall test stand, the so-called boiler wall.

## Teaching and lectures

Prof. Dr.-Ing. Andreas H. Holm

“Bauphysik – Grundlagen.”

[Fundamentals of building physics.]

University of Applied Sciences, Munich

“Dynamisches hygrisch-thermisches Verhalten von Gebäuden.”

[Dynamic hygrothermal behaviour of buildings.]

TU Munich

# TIPCHECK



The comprehensive inventory of insulation material samples at the FIW München allows for demonstrative understanding of material sciences. The various measurement principles, for example for temperature measurement, can be easily practised by using the FIW test instruments.

**Contact person:**

Karin Wiesemeyer und Marie Bernthaler

## Presentations

**Prof. Dr.-Ing. Andreas Holm**

- “Freiwilliges Qualitätssicherungssystem – die Branche nimmt Verantwortung ernst” [Voluntary quality assurance systems – the industry takes over responsibility] – 2nd Technology Day for Insulation Systems in Berlin, Kalkscheune, on 3 November 2016.
- “Der Übergang von staatlichen zu privaten Überwachungssystemen” [The transition from state to private monitoring systems] – EPS Particle Foam in Würzburg, Marienberg Fortress, on 24 February 2016.
- “Wärmedämmung der Zukunft – Aus der Kritik gelernt” [Heat insulation of the future – learned from criticism] – Mortar Days in Bamberg, on 28 and 29 April 2016.
- “Dämmstoffe – Eine Entwicklungsgeschichte” [Insulation materials – a history of development] - 32nd International WTA Colloquium in Hildesheim, on 10 March 2016.
- “Gebäudesanierung und CO<sub>2</sub>-Einsparung” [Refurbishment of buildings and CO<sub>2</sub> savings] – 11th GRE Conference 2016 in Kassel on 17 March 2016.
- “Digitalisierung: auch ein Thema für die Gebäudehülle” [Digitalisation: also a topic for the building shell] – 2016 Berlin Energy Days in Berlin, on 11 April 2016.
- “Wann lohnt sich Dämmen?” [When does heat insulation pay off?] – 55th GSH members’ meeting in Hamburg, on 13 May 2016
- “WDVS – Untergründe und Systeme” [ETIC – subfloors and systems] – 27th Hanseatic Refurbishment Days in Heringsdorf, Usedom, on 5 November 2016.
- “Kosten versus Energieeffizienz: Optimierung von Niedrigenergiehäusern für die EnEV 2021” [Costs vs. energy efficiency – optimisation of low-energy houses for EnEV 2021] - Masonry Forum in Berlin (DIN), on 29 November 2016.
- „Economic efficiency of thermal insulation aimed at saving energy: A critical assessment” - Buildings XIII Conference of the Oakridge National Laboratory in Clearwater, Florida, on 7 December 2016
- “Einfluss des Dachdämmaufbaus auf dem sommerlichen Wärmeschutz” [Impact of roof insulation design on summer heat protection] - Munich consumer advice centre, on 15 July 2016

- “EnEV 2021 und Anwendung auf die Gebäudehülle” [EnEV 2021 and application for building shell] - geea members’ meeting in Berlin, on 15 June 2016
- “Aktuelle Diskussion um die EnEV” [Current discussion on EnEV] - Bundesverband Baustoff-Fachhandel e.V. in Berlin, on 12 October 2016

**Christoph Sprengard**

- “Dämmstoffe für Innendämmungen - Etablierte Materialien und neue Entwicklungen” [Insulation materials for interior insulation - established materials and new developments] at the FV ID Symposium on presentation of the Praxishandbuchs Innendämmung in Munich, on 3 March 2016
- “Hürden bei der Markteinführung innovativer Hochleistungsdämmstoffe” [Barriers for market launch of innovative high-performance insulation materials] at FIW München Research Day in Munich, on 22 June 2016
- “Produktnorm Vakuum-Isolations-Paneele für Bauanwendungen” [Vacuum insulation panel product standard for construction applications] at FIW München Research Day in Munich, on 22 June 2016
- “VIP im Bauwesen seit 1998 – vom Prototypen zum genormten Dämmstoff” [VIP in construction since 1998 – from prototype to standardized insulation material] at 12. Fachforum innovative Dämmtechniken within scope of Messe Nordbau in Neumünster, on 8 September 2016
- “Influence Factors on the measurement of internal pressure of VIPs” at “Innovative Insulation Materials” workshop within scope of Buildings XIII Conference of the Oakridge National Laboratory in Clearwater, Florida, on 4 December 2016
- “Vacuum-Isolation-Panels - Calculation of increase of thermal conductivity according to differing climatic influences” at “Innovative Insulation Materials” workshop within scope of Buildings XIII Conference of the Oakridge National Laboratory in Clearwater, Florida, on 4 December 2016
- “IEA Annex 65: Long-Term Performance of Superinsulating Materials (SIM)” at the “Innovative Insulation Materials” workshop within scope of Buildings XIII Conference of the Oakridge National Laboratory in Clearwater, Florida, on 4 December 2016





- "Determination of linear thermal Transmittance of Vacuum-Insulation Panels by Measurement in a Guarded-Hot-Plate- (GHP) or a Heat-Flow-Meter- (HFM) Apparatus" at the Buildings XIII Conference of the Oakridge National Laboratory in Clearwater, Florida, on 5 December 2016

**Wolfgang Albrecht**

- "Neue Regeln für EPS-Dämmstoffe nach dem EuGH-Urteil?" [New rules for EPS insulation materials after the ECJ judgement?], EPS particle foam expert meeting, Würzburg, on 24 February 2016.
- "Die neue DIN 4108-4 nach dem EuGH-Urteil" [The new DIN 4108-4 after the ECJ judgement], FIW Research Day, Munich, on 22 June 2016.
- "Neue Anwendungsregeln für Dämmstoffe (DIN 4108-4 und DIN 4108-10)" [New application rules for insulation materials (DIN 4108-4 and DIN 4108-10)], IBP Expert Symposium on Insulation materials and Insulation Systems, New Developments and Knowledge, Stuttgart, on 11 October 2016.
- "Technical questions of certification", Thermal Insulation KEYMARK Conference, Berlin, on 18 – 19 October 2016.

- "Low lambda products, experience on how to handle", Thermal Insulation KEYMARK Conference, Berlin, on 18–19 October 2016.

**Holger Simon**

- "Neue Randbedingungen für das Ausstellen von Energieausweisen" [New boundary conditions for issuing of energy certificates], Munich Bauzentrum, on 15 March 2016
- "Wärmebrücken bei innen gedämmten Konstruktionen" [Thermal bridges of interior insulated structures], IBP Holzkirchen, on 20 April 2016

## Publications



Holm, A.; Gertis, K.; Maderspacher, C.; Sprengard, C. (2016). Kritische Überlegungen zur Wirtschaftlichkeit von energiesparenden Wärmeschutzmaßnahmen. [Critical considerations on economic efficiency of energy-saving heat insulation measures.] Bauphysik, 1.

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Holm, A. (2016). Editorial. In Industrieverband Werk Mörtel e.V. (editor), "Der Ratgeber rund um die Außenwand" [advisor on the external wall] (p.2). Duisburg.

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Maas, Anton (2016): Energy Saving Ordinance 2016. In collaboration with Andreas Holm. Issued by Kalksandsteinindustrie e. V., Gesellschaft für Rationelle Energieverwendung e. V. Hanover.

Holm, A. (2016). Mit Vernunft gegen Vorurteile. [Reasonably overcoming prejudices.] Althaus modernisieren, 2/3 2016, 54 – 55.

Holm, A. (2016). Dämmen: Es rechnet sich!. [Insulation: it pays off!] Althaus modernisieren, 12/1 2016, 38 – 41.

Holm, A. (2016). Zur Dämmung von Außenwänden mit Innendämm-Systemen (IDS) [Regarding insulation of external walls using interior insulation systems], 2nd edition.

## Bachelor and Master theses

In collaboration with the Technical University of Munich (TUM) and the University of Applied Sciences Munich, the following student theses were supervised in 2016:

### Susanne Regauer

“Measurement of interior pressure with vacuum insulation panels (VIP) – examinations on the impact of boundary conditions when measuring the interior pressure of VIPs by means of film lifting method“.

Technical University of Munich, seminar paper in the subject of Construction Physics.

### Nicolas Sedlmayr

“Thermal measurements with an exterior wall insulated on the inside with including concrete ceiling – comparison with numerical calculations for the stationary and transient case.“

University of Applied Sciences Munich, Faculty of Civil Engineering, Bachelor thesis.

### Ramona Holland

“Examination of fRsi-values using 2D and 3D simulations of internally insulated existing structures – comparison of the temperatures determined under stationary and transient conditions from 2D and 3D simulations for assessment of mould growth.“

University of Applied Sciences Munich, Faculty of Civil Engineering, Bachelor thesis.



**From theory to practice – real sustainability at the FIW München**

Not only buildings and industrial insulation contribute to sustainable climate protection, but also and in particular every single person. For several years, the FIW München has been providing an institute-wide bicycle list for documentation of the bicycle kilometres ridden to the workplace. The concept of mutual measurement, e.g. measuring how often and how far the bicycle is used, has an encouraging effect. But it is not only the mutual comparison that is encouraging, but also the goal to jointly make as much kilometres as possible and to save CO2 with the own muscle power. Another positive side effect is that health problems disappeared and the usual Munich traffic jams are avoided. In 2016, the FIW München had a very successful bicycle year with a total of 23,335 bicycle ki-



lometres (which corresponds to CO2 savings of approx. three tons). For actively supporting this commitment, the institute management decided to donate one tree per ten bicycle kilometres within scope of the Plant-for-the-Planet children and youth initiative. Finally, this amount was rounded up to 2500 trees; this way, FIW München individually, but also jointly supports a healthier way of living and a sustainable climate protection, correspondingly resulting in a better future.



**Imprint**



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