Services for Research and Testing of Construction Products

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IHD Research Focus on Construction Products

The Institut für Holztechnologie Dresden (IHD) has been carrying out research and development tasks in the field of building products for many years.
The focus here is on the following topics:

Materials

- Production and analysis of particle- and fibre-like particles from wood and annual plants and their use for the production of materials
- Development of low-emission materials using alternative binders and cross-linking systems and additives
- Process developments for the recycling of waste wood and wood-based materials, taking the design of recycling into account
- Technology optimisation through energy and material savings in the manufacture of sustainable and ecological products

Surface

- Coatings for e.g. floor coverings, wall coverings or furniture to improve their usability and safety-relevant properties
- Evaluation of the durability of coatings on materials under the influence of weathering
- Fire behaviour (heat release, smoke formation) of surface coatings for product assessment
- Use of bio-based raw materials in coatings to achieve improved properties

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Constructions

- Development of construction elements with special product properties (e.g. flood protection)
- Development of test methods (e.g. procedures for the localization of moisture events in wall and ceiling elements)
- Design of composite systems (numerical consideration of moisture and thermal protection problems, etc.)
- Selected acoustic investigations on small-format specimens as well as building components

Department Materials

Materials from renewable sources are in vogue and are characterised by an environmentally friendly and functional character. Accordingly, the Department of Materials focuses on the production and analysis of particles and fibres from wood and annual plants as well as their use in the production of materials (boards, moulded parts, special products).

In the pilot plant, the entire supply chain from round wood to the finished board can be traced. The range of services is supplemented by special tests, e.g. determination of the density profile perpendicular to the board plane, dielectric loss, wetting behaviour, creep behaviour, duration of load and dimensional stability.

Current topics in the development of wood-based materials are e.g. the testing of alternative binder and cross-linking systems, additives for low-emission materials, process developments for the recycling of waste wood and wood-based materials and raw density-reduced boards using new materials and particle geometries. Furthermore, current research projects are investigating the potential of HF technology regarding alternative manufacturing options for low-emission particle and layer materials.

In addition to classic defibration units (including chippers, mills and refiners) for the production, drying and fractionation of wood chips, shavings, strands and fibres, is also an eddy current mill available for the production of ultra-fine powders or for the defibration of waste paper and annual plants. A steam explosion reactor for lignocellulosic feedstocks enables the complete collection and balancing of the digestion products (solid, liquid, gaseous).

The technical equipment and technological

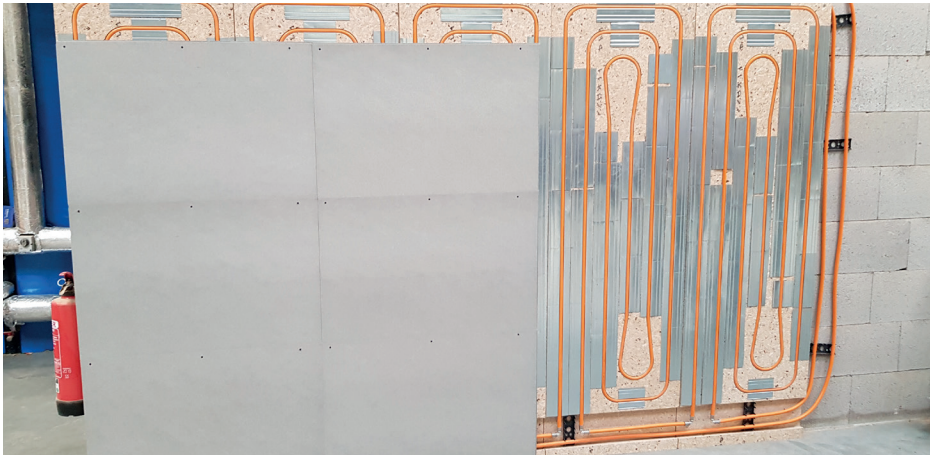
know-how for industry-analogue material production is available. This allows the implementationof the individual processes for the production of organically and inorganically bonded wood-based materials, from drying and gluing to pressing of the finished product. Technological optimisations in the production of wood-based materials aim the energy and material savings as well as the production of sustainable and ecological products.

High-frequency press

Fibre mat forming line

Camsizer (Dynamic Image Analysis)

Room Temperature Element for Heating/Cooling



Initial situation

The heating of rooms and buildings by means of panel heating systems has been state of the art for a long time. Surface heating systems are available for floors, walls and ceilings and are all integrated into building component surfaces. Panel heating systems increase thermal comfort by heating the surrounding surfaces. Due to the low system temperatures required for this, they are particularly suitable for the use in connection with modern condensing boiler technology, heat pumps and solar thermal energy. In the meantime, these systems are also used to cool rooms.

There is a big optimization potential in the existing panel heating and cooling systems regarding to the improvement of:

- the long time required for installation (when laying the pipes on site) and plastering (when using room-enclosing plasters),
- the high weight,
- the lack of the possibility of non-destructive disassembly during dismantling (the issue of reusability or separation by type), and
- the presence of integrated insulation.

In order to combine these aspects in a room temperature control element, the partners WEM GmbH, UdiDämmsysteme GmbH, MFPA Weimar and the IHD realised a corresponding project.

Procedure

During the project, after extensive simulations of possible structures, tests were first carried out to produce the elements on a pilot plant scale using various materials. Three-layer

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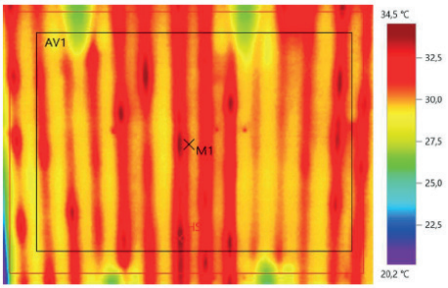
solid wood panels and single-layer coarse particleboards were used as support boards. Pipes for heat transfer (16 mm multi-layer composite pipe) were inserted in milled channels. At last, panel-shaped elements made of wood (beech, spruce) and mineral materials (gypsum, fibre cement) as well as clay plasters were used as cover layers. On the backside, compression-resistant wood fibre insulation boards and flexible wood fibre insulation mats were glued to the carrier boards. In the course of optimising the structure of the elements, fastening variants of the panel-shaped cover layers on the carrier boards (screw connection, detachable magnetic connection) and the use of heat distribution plates were investigated. Subsequently, real-scale elements (200 cm x 62.5 cm) were produced. A test wall was constructed and thermally measured.

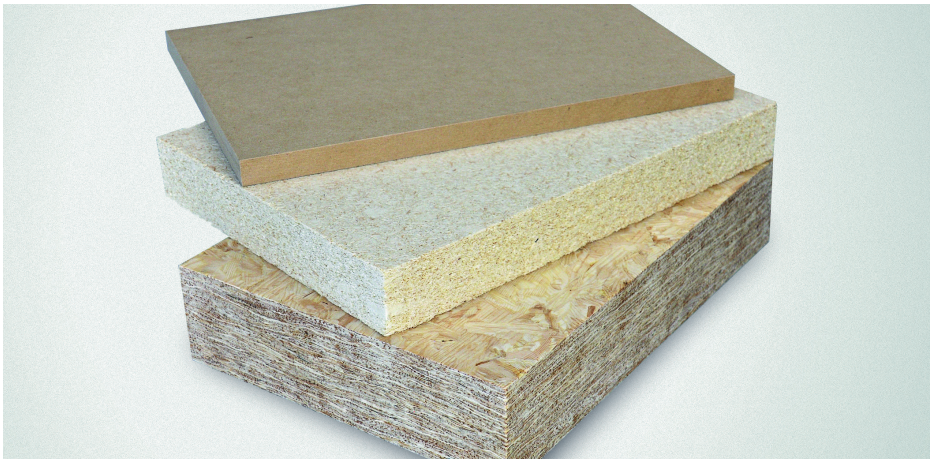
Results

The goal of developing a room temperature control element with heat output values similar to those of the existing systems, but with a significantly higher degree of prefabrication and significantly less installation effort, was achieved. The elements can be completely prefabricated in the factory. On the construction site only the elements (support boards with inserted pipes, heat distribution plates and insulation glued to the backside) are simply screwed to the existing wall, the pipes of the individual elements are connected to each other and the cover layers (fibre cement panels) are fixed to the support board of the elements.



Surface temperature of the test wall

High-Frequency Technology



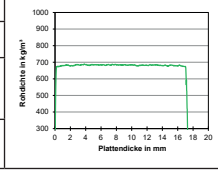
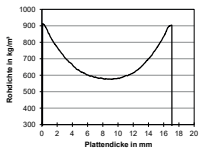
The heating of the particle mat by electromagnetic waves does not require a heat transfer medium and is therefore not based on heat convection and the associated challenges in heating a fibre mat with a high air content. It involves the conversion of electrical energy into heat in non-conductive materials, initiated by an alternating electromagnetic field penetrating the particle mat. The dipoles or charge carriers contained in the mat are thereby excited to oscillate and heat is generated by the friction of the oscillating particles with the surrounding material. The high-frequency field (HF) used for heating is generated with a very uniform field structure between two capacitor plates. In contrast to microwave technology the capacitor plates can be press plates at the same time. Based on the high-frequency preheating of the mat to 70 - 80 °C, which is already known from the industrial application of particleboard, located before the hot press, the HF through-heating process and the HF three-layer process were developed at the IHD. Both processes go one step further and rely on the curing of the adhesive at least in the middle layer. The processes document the possibility of generating high temperatures in the particle mat in a short time with high-frequency heating through appropriate substrate configuration.

With the HF heating technology the mat (after conventionally mat building process) is compacted to final board thickness. Then the HF field is heating up applied to the pre-compressed mat to 130 °C (in some cases up to 170 °C). The heating is accelerated by using a special HF adhesive, which efficiently converts the HF energy into heat. After leaving the HF press, the board has already reached final strength and no further pressing step in

a hot press is necessary. The HF three-layer technology is a further development of the HF-heating process, which was developed for the production of lightweight wood particle boards with a high surface layer density. The process starts also with the compression of the conventionally produced mat. The HF field is then applied to the precompressed mat. In the HF press, due to the application of the HF adhesive exclusively to the middle layer particles, only the middle layer of the mat is heated up to 130 °C. Afterwards the surface layers are compressed to final thickness in the hot press. The already cured middle layer acts as an internal press plate.

Another method is the selective high-frequency preheating method for the production of particleboard at high core layer temperatures. With this technology, inert, low-formaldehyde or formaldehyde-free or biogenic adhesives at press speeds, comparable to particleboard production, with fast-reacting, established E1 adhesives can be processed. Initiated by the HF press, a rapid temperature increase to over 130 °C is generated in the core layer. This temperature increase leads to a drastic increase of the reaction speed of the inert adhesive in the core layer and causes the adhesive to cure within a short time.

Table 1: Comparison of the properties of a particleboard manufactured according to the HF through-heating process with a conventional particleboard (thickness: 17 mm)

Properties/Parameters	HF Particleboard		Reference particleboard, single layer	
Raw density	670 kg/m^3		680 kg/m^3	
Bending strength	22 N/mm^2		28 N/mm^2	
Internal bond strength (dry)	1.32 N/mm^2		0.94 N/mm^2	
Press time factor	**6 s/mm**		**10 s/mm**	

Recycling of Wood and Wood-based Materials

Initial situation

The wood-based panel industry in the European region is at a high level despite the past crises. Regarding the high demand to this product group two economic challenges play an important role:

- The development of new raw material sources
- The increase of the recycling rate

Currently, mainly coniferous wood is used as a raw material, which will no longer be available to the current extent in the future. Due to the necessary forest conversion towards more deciduous and mixed forests and the additional calamity years (2018 - 2020), a medium-term shortage can be assumed. On the other hand, the political pressure on wood-based material manufacturers has increased, both in Germany by the Recycling Management Act and at the European level by the "Green Deal". As a raw material source, waste wood offers a currently untapped potential in the production of fibre boards. The focus here is on the german waste wood classes A I and A II.

Challenges

Technological adaptation regarding the defibration process are necessary for the implementation of waste wood. Despite the legal requirement that A I waste wood should only be mechanically processed natural wood, the material flow contains adhesions of wood-based materials, plastics (packaging films) as well as nails and fittings. This requires a much higher sorting effort before the actual refining-process.

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Although the chipping and defibration requires an adjustment process due to the lower wood moisture content of waste wood. Chipping produces a higher percentage of fines and the cutting forces (and correspondingly the wear) increase.

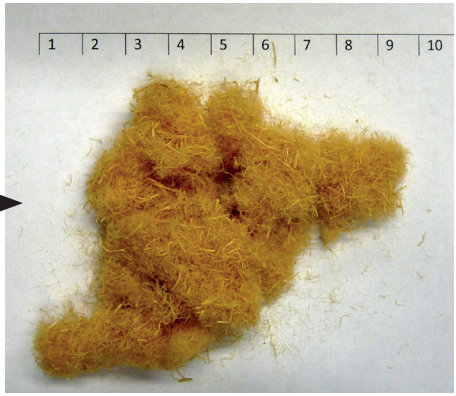
In the recycling of MDF, technical solutions are sought to remove coatings on the one hand and to return the recycled fibres to the manufacturing process as efficiently as possible on the other.

Process

In cooperation with partners, the use of near-infrared (NIR) and X-ray transmission spectroscopy (XTR) combined with electromagnetic search coils to separate out plastics, wood based materials and metals was developed. The higher percentage of fines can be minimised by adjusting the drum speed of the chipper.

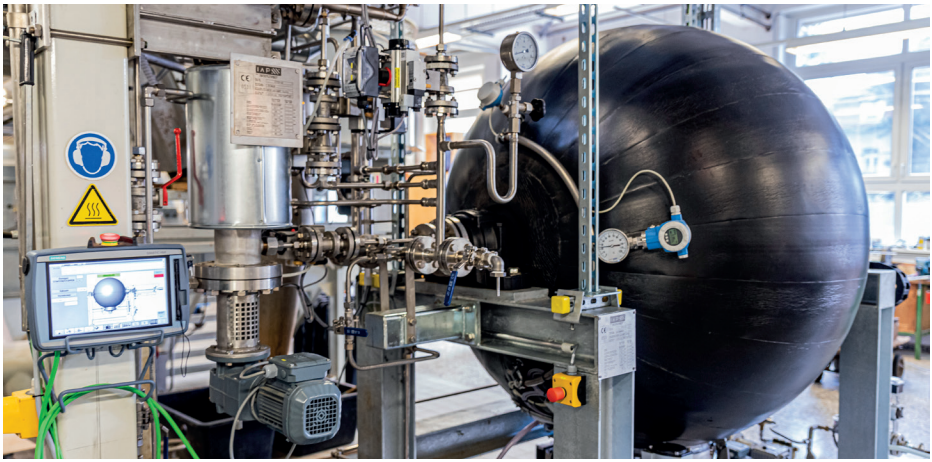
Recycling MDF requires successful separation of the coating material. Subsequently, chips can be produced from MDF and fed into the existing defibration process via a variable feed system. The defibration process can be adapted to the lower wood moisture content by adapting the process parameters pressure and retention time in the digester.

Waste wood to be used for defibration (cleaned up and re-shredded)



Fibre made from 100 % waste wood AI

Steam-Explosion Technology



Initial situation

The defibration of lignocellulosic material, patented by William H. Mason in 1926, is based on the physical expansion of water during the transition from the liquid to the gaseous phase. In its basic forms, the process consists of a container filled with the raw material, which is pressurised with saturated steam and, after a certain reaction time, is suddenly depressurised by opening a valve. The resulting defibration forms the basis for a wide range of applications. By varying the pressure and retention time, controllable and definable properties can be obtained from the starting material.

Due to the intended substitution of fossil raw materials by biological materials for the production of plastics, there is a need for platform chemicals (e.g.: Furfural). With a product-based control of the Steam-Ex process, a tool is available to meet this demand.

Challenges

The focus of the investigations is the balancing of the Steam-Ex process with regard to the raw materials and the process parameters (pressure, cooking time). The development of a suitable reactor was necessary to represent a large variability. The pressure to be achieved should be above 20 bar in order to trigger the desired chemical reactions. In addition, the process should be well reproducible and all reaction products should be absorbed.

Process

A 10 l reactor with an operating pressure of max. 32 bar was developed. To quantify the resulting products, the reactor is connected to a 1,700 l collecting tank. This allows the determination of solid, liquid and gaseous reaction products. Furthermore, the set process parameters are stored in a process control system together with the energy consumption (steam consumption). This arrangement makes it possible to quantify the process in an energetical and chemical way.

Raw material: Chips of pine, fresh from the forest, fraction 3 - 15 mm

Fibre after a boiling time of 15 min at 30 bar

Wood-hybrid Materials

Initial situation

Different raw materials are used for the production of construction materials. A distinction can be made between organic and inorganic construction products. Construction products made of wood belong to the first group. In recent centuries, wood has been increasingly replaced by inorganic construction products, especially concrete and steel. During the last years the share of timber constructions has increased noticeably again. This is primarily due to the significantly lower CO_2 emissions of wood-based construction products.

In its built state, wood stores the bound CO_2 and thus acts as a carbon sink. Compared to concrete buildings, the shorter lifespan and higher maintenance costs of wood often have a negative impact on the environmental balance. In addition, wood is at a disadvantage compared to inorganic construction products, mainly due to its limited resistance to water and fire.

Challenges

Each material can be assigned specific positive and negative properties. The combination of monolithic structures can on the one hand lead to synergies and on the other hand reduce the use of materials and thus save resources.

Well-known examples of hybrid and composite materials are inorganic mixtures such as fibre-reinforced plastics (e.g. CFRP) or reinforced concrete.

The bonding between inorganic and organic materials, such as concrete and wood, is much

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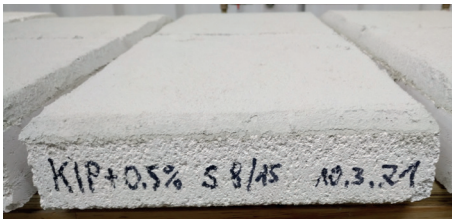
more complicated.. The chemical composition of lignocelluloses could affect unfavourable interactions at the boundary layers. However, increasing the proportion of renewable resources in inorganic materials can only succeed by producing a high-performance material composite.

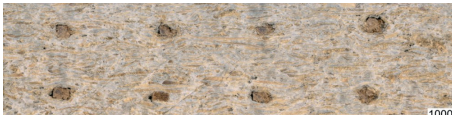
Research

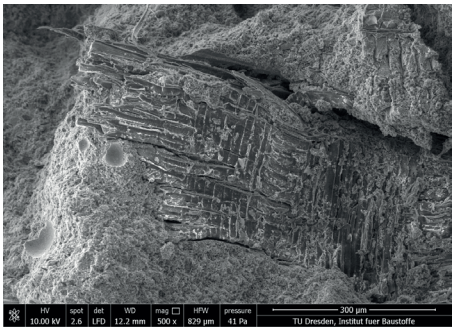
In recent years, the IHD has successfully developed various hybrid materials from renewable raw materials and inorganic binders:

- CBPly
  laminar composite of veneers with cementitious binder to plywood with high fire resistance
- LignoPutz
  Lightweight plaster mortar with wood as reinforcement instead of plastic fibres (partner: SAKRET)
- Wood fibre reinforcement
  Wood fibres (comparable to steel reinforcement) for increasing the tensile strength of cement-bonded particleboards
- Lignocellulose lightweight concrete
  Combination of low-emission and fast-hardening CSA cement and lignocellulose lightweight aggregates



Lightweight interior lime plaster with wood chips on aerated concrete


Wood thread reinforcement in cement-bonded particleboards



SEM image of wood shavings in CSA matrix

Protein-bonded Wood Materials

Initial situation

Urea-formaldehyde (UF) or melamine-reinforced urea-formaldehyde resins (mUF) are still state of the art in the manufacturing of wood-based panels.

Formaldehyde can be emitted from the boards during manufacturing and later during use. With the amendment of EU Regulation 1272/2008 (CLP-V), formaldehyde was classified as harmful to genetic material and probably carcinogenic to humans. The consequence is a further tightening of the limits regarding the emission of formaldehyde. With specific adhesives based on renewable raw materials, wood-based materials (particleboard) can be produced that have sufficient strength for applications in the furniture sector. However, the glue systems show problems in application and technological values. In addition, the product often has too low moisture resistance. This is forcing the development of alternative formaldehyde-free binders.

Challenges

Due to the prospectively decreasing use of formaldehyde-containing adhesives for wood-based materials, new, formaldehyde-free, protein-based binder systems are to be developed using residues from agricultural production or by-products of starch production. The new adhesive system should be easy to apply and enable the production of standard-compliant wood-based materials. Suitable technological settings should be found that can be implemented in practice. The boards should have very low formaldehyde emissions and be coatable.

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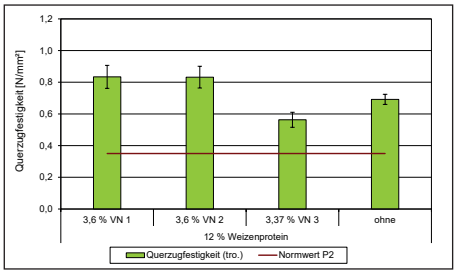
Process

The proteins are either dissolved or applied in powder form (delivery state). Not all proteins are water-soluble, which entails additional effort in the preparation of the glue solution. Better board properties were obtained with a higher particle moisture content before pressing.

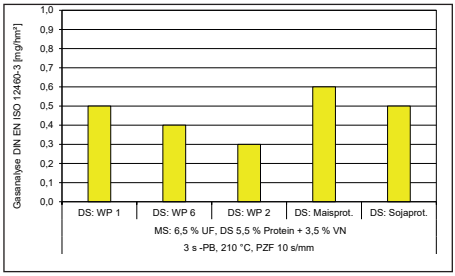
Together with the low solid contents is a long pressing time necessary. The use of HF technology leads to better board properties, as temperatures up to 160 °C can also be applied in the core of the board. MDF, SWP or OSB can also be produced using protein gluing systems.

Properties

Protein isolates enable the production of P2 particleboard. There is no difference between various suppliers. Besides wheat proteins, casein and soy protein have also proven to be suitable. Alternative residues such as corn steep liquor, sunflower protein, potato protein or rapeseed cake were more difficult to apply and resulted in insufficient board properties. Crosslinkers (CL) led to an improvement in the properties. There is potential for optimisation with regard to adhesive content and pressing conditions. With a three-layer structure, the proteins in the surface layers have a formaldehyde-lowering effect. The UF resin in the core layer determines the panel properties so that the standard values (e.g. P2 according to EN 312) are reliably met.



Internal bond of single-layer particleboards with wheat protein and different crosslinkers (CL)



Formaldehyde emission (gas analysis value) of three-layer particleboards with proteins in the surface layers

Development of an adaptable care bathroom furniture

Initial situation

Nursing care in the bathroom takes place in a wide variety of spatial situations. Camped environments make working conditions more difficult for caregivers. Our own preliminary work has shown that the structural situation in rented apartments is generally insufficient for self-determined use by people with severe motor impairments. Additionally present caregivers need further space, which is mostly not available. To date, no detailed studies have been available on the requirements for the spatial design and equipment of bathrooms for home care. The current shortage of skilled workers requires much improved working conditions for caregivers, otherwise the situation is likely to worsen drastically.

Challenges

A wide range of aids is also required for nursing care. Within the project, suitable room furnishings were to be developed that enable care under ergonomic conditions and address particularly cramped room situations. The project also aimed to support risk minimization through fall prevention. Therefore, care-giving relatives and the person in need of care should be able to handle the newly developed equipment intuitively as far as possible.

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Procedure

The spaces within reach of the person in need of care were determined with the aid of a motion capture system in test person trials using the MAX age simulation suit. To determine the relevant usage sequences, caregivers were interviewed, care standards were evaluated and care scenarios were documented. Afterwards, the required aids and care products were assigned to the identified usage steps in the respective room situation. During the first interaction experiments, the care scenarios were simulated and optimisation possibilities identified. After completion of the equipment concept, the solutions of individual equipment elements were further developed into a complete equipment system. This was followed by the production of various demonstrators and their installation and testing in the realistic test environment (see figure). The equipment concept and system were evaluated in project-accompanying presentation rounds before specialists from care and industry.

Results

The result of the project is a multifunctional equipment system that can be adapted to the respective tasks and places of action. This flexibility allows a step-by-step positioning of the required aids at the place of action, so that a clearly arranged overall situation with generous movement areas is created. The equipment system consists of a retrofittable railing system, which is also designed for attaching handrails, a box and storage system for specific workplace equipment, and a multifunctional trolley that can be expanded into a mobile washing station.

The railing system can be easily attached to any ordinary bathroom wall. Arranged at different heights, they serve to flexibly accommodate the system components, but also integrate indirect lighting and the power supply. The boxes belonging to the system are ergonomically designed, stackable and easy to grip with one hand. In addition, they can be lined up in front of each other and transported in pairs with one hand. The functional trolley picks up the railing system and can thus be used with all objects of the equipment.

User's Guide for Exterior Wood Coverings

Initial situation

Wood decking for terraces, balconies, platforms, bridges, etc. is one of the most important uses of solid wood products in outdoor areas; at the same time, there are major challenges here, as the decking is very heavily stressed by weathering and also by use. Problems also arise in part from the fact that timber decking is installed by both professionals and non-professionals. Despite rising sales of outdoor coverings overall, the share of solid wood is declining.

Project

In the EURODECK project (2020-2022; EU programme CORNET), IHD and Holzforschung Austria dealt intensively with all aspects of outdoor wood coverings. The aim was to increase product quality and safety and consumer confidence, to strengthen demand and sales as well as the market position of the companies and to reduce the complaint rate and costs. In addition, the foundations were to be laid for a European product standard "Wooden coverings for outdoor use".

Concept

The starting point is 7 types of use, representing the most important practical cases. On the basis of 6 criteria each, the fitness for use and the service life can be ensured. Each criterion includes properties for which special requirements exist. These in turn result from contractual agreements, legal requirements, standards, technical rules and other

conditions of the individual case.

User guide

The User's Guide is the first comprehensive quality and assessment programme for exterior wood coverings. In addition to the planning aid itself, it contains leaflets and information on 25 topics and 7 types of wood as well as a comprehensive list of relevant standards, regulations and publications.

The structure is modular, i.e. the individual elements can also be used independently of each other, e.g. for customer information or for planning, tendering or quotation preparation.

The user guide has both a print version and an electronic version (pdf format). It can be obtained for a nominal fee from https://www.ihd-dresden.de/de/wissensportal.

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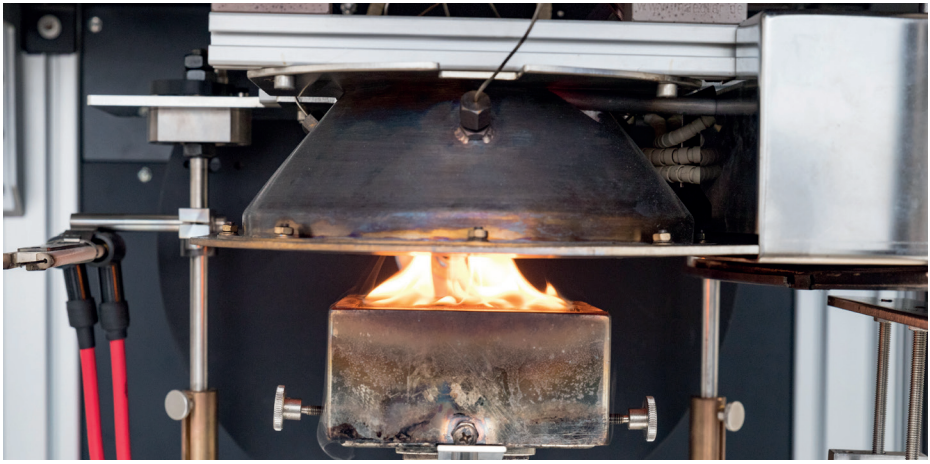
Novel Flame Retardants for Wood Coatings



Objective

The objective of the project was to synthesise novel host-guest complexes (Cplxes) of native or chemically modified cyclic oligosaccharides (cOS) and organophosphorus compounds (POV). The complexes are expected to be applied as environmentally friendly and high-performance, largely organic-based and water-soluble flame retardants (FSM) for flame retardancy of aqueous wood-coating systems or as flame retardant impregnations for lignocellulose-based materials.

Approach

Emphasis of this project was on:

- the development of methods for the synthesis of cOS derivates and Cplxes;
- the investigation of the structure-property relations of the cOS derivates und Cplxes, into their flame-retardant effect and into the underlying mechanisms of such effects;
- the development of Cplx-modified, flame-retardant aqueous impregnations and formulations for wood-coatings and
- the application of Cplx-modified coating materials and the identification of the thermal behaviour and reaction to fire of the materials equipped with Cplxes.

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Result

The project was able to provide proof of successfully generating host-guest complexes out of entirely organic-based cOS with aryl phosphates and aryl phosphonates. It could be shown that

- the water solubility of the non-polar POV is significantly improved by complexation with cOS, thereby clearly enhancing their formulability in aqueous polyacrylate dispersions;
- an increase in the efficiency of the POV with regard to their flame-retardant effect is achieved through synergistic interaction of them with the cOS matrix in the Cplx.

Therefore, in contrast to non-complexed POV and compared to conventional flame retardants (such as ammonium polyphosphate, APP), Cplxes show enhanced effectiveness. In addition, Cplxes that contain large shares of regenerative raw materials represent a sustainable solution for coating materials or wood surfaces/veneers that need to be equipped with flame retardant properties.

For their flame-retardant functional groups and guest compounds, the complexes cause significant improvement in the reaction to fire of Cplx-modified waterborne wood coatings, of appropriately impregnated or coated veneers or veneered material composites.

Project leader: Dr. rer. silv. Lars Passauer

PUR Binders for Clearcoat Applications

Objective

In the case of high-gloss and transparent wood coatings, (reactively) flame-retardant coatings based on polyurethane binders often show haze, discolouration or loss in gloss. Due to the bans on classic halogen-containing flame retardants (FR), there is a need for alternative halogen-free flame retardants acting in situ in order to continue to meet the high flame retardancy requirements for interior products.

The objective of the project was to develop (a) flame-retardant Si/N-containing bonding-agent components (especially polyols) for (b) novel, hardly flammable transparent 2K-PUR coating systems including technologies/synthesis regulations for (c) the presentation of bonding-agents (or components thereof) and (d) their formulation in coating systems as well as the application and curing of these systems.

Approach

At the start of the project, referential systems (clear coats) were characterised and property profiles drafted. The syntheses planned for a large amount of Si polyols initially led to the extensive generation of side products, but could be accomplished in the course of the project. Five clearcoat systems were formulated using the presented Si polyols and initially characterised by TGA (Fig. 1).

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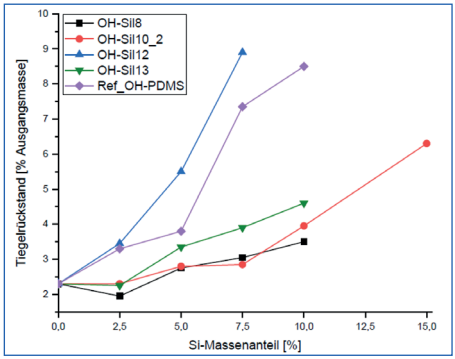
Result

It became evident that structurally varied silicon compounds differ in efficiency in terms of the flame-retardant effect, but that for all systems an increasing silicon content is linked to an increasing combustion residue. In a nutshell, it can be stated that the presented Si polyols are well suited to formulate transparent PUR clearcoats. Coating produced with two of the developed compounds yielded significantly improved flame retardancy, which could be demonstrated by means of both TGA and cone calorimetry. These investigations show the potential of silicon-containing structures in polyols with regard to improved flame retardancy in transparent PU coatings.



TGA characterisation of different Si polyols

Fast-curing, Organic-based Polyurethane Bonding Agents

Objective

Coating systems based on regenerative raw materials (NawaRo) are still a niche product. In the field of isocyanate-free polyurethanes (NIPU), this project aimed at creating conditions for making organic-based poly(hydroxy) urethane binders (PHU) competitive over conventional polyurethanes (PU). The goal of the project was to advance knowledge on classic and hybrid NIPU binders based on sustainable resources that cure as quickly as already established isocyanate-based PUR systems.

Approach

For that purpose, six synthesis routes for multifunctional cyclic carbonates were initially developed and carried out, and the products were characterised structurally. From among them, three systems immediately proved to be over-reactive, so that too many side reactions occurred during synthesis. Out of the three remaining ones, two were selected that resulted in a rigid/aromatic and a flexible/aliphatic dicarbonate ("TDC" and "ADC", respectively). In the course of the project, the syntheses for TDC and ADC have been further optimised, so that methods are now available that lead to high yields and sound purity.

Furthermore, extensive polymerisation tests were performed to gain better understanding of the reaction behaviour of the NIPU systems. The systems and methods developed allowed to obtain fully cured coatings in application tests at room temperature without further addition of curing agents or hybrid curing mechanisms. The primary goal of the

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project was achieved by that. Furthermore, hybrid NIPU binders were to be developed that could be cured at room temperature. In the project, all three goals/systems were accomplished, and the curing behaviour of these systems was evaluated with reference to non-modified NIPU.

Result

It can be summarised that the development of NIPU coating systems curing at room temperature was achieved and that the potential of hybrid NIPU systems as coating agents for the three tested variants (epoxy, silane, unsaturated NIPU) could be proven. This has created a broad basis for development work close to the market.

EPH-Range of Services for Construction Products

Product fields and fields of activity

The Entwicklungs- und Prüflabor Holztechnologie GmbH (EPH) is mainly busy in the field of timber, wood-based panels e.g. particle boards, plywood, OSB, solid wood panels, floorings (resilient, MMF, laminate, parquet and wood floorings), windows and doors, facades, wall panels (e.g. HPL, solid wood, cork panels) and boards for thermal insulation.
The EPH provides testing services as accredited test laboratory according to EN ISO 17025 and Notified Test laboratory (NB 0766). Furthermore, the EPH is a Notified Body for certification of these products or FPC's in the AVCP systems 1 and 2+. The EPH has also an accreditation for the certification of management systems and sells test equipment for VOC/FA emission testing.

Testing activities

In the different EPH laboratories mechanical, biological, chemical and surfaces tests of construction products are conducted. The special focus is on health, energy-saving and safety relevant properties e.g. selected reaction to fire tests, mechanical tests for products with structural loads, determination of thermal resistance, all common slippery resistance test, tests on formaldehyde- and VOC emission, the content of dangerous substances and resistance against biological threats.
Also fit for use properties e.g. wear and chemical resistance of surfaces, dimensional stability under influence of temperature and moisture or weather resistance are in the range of service.

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Product/Management Certification Body

The EPH issues certificates for constancy of performance of products according to system 1 of the CPR and for conformity of the Factory Production Control (system 2+) for construction products based on accreditation according to EN ISO 17065/Notification of the EU. Approximately 200 plants worldwide are served by EPH.

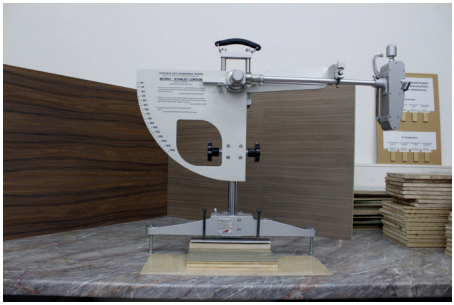
Furthermore, EPH is a globally recognized CARB/EPA-TPC for formaldehyde emission from wood-based materials.

It is also accredited as certification body for management systems (EnMS, UMS, QMS) according to EN ISO 17021 and provides such service to manufacturers of construction products.

Further activities

The EPH also offers a trainee program for education on test methods regarding selected construction products (e.g. flooring, wood- based panels VOC- and formaldehyde emission combined with practical exercises in our laboratories.

The development and distribution of formaldehyde and VOC emission test chambers (chamber systems and gas analysers) as well as selected surface test devices is a working field of the EPH too. In course of the delivery a training of the lab stuff and comparison tests can be agreed.



Pendulum test for the determination of slippery resistance

Notified Body and Recognized Body according to LBO

European Notified Body (No 0766)

The EPH works worldwide as Notified Testing and Certification body in the AVCP systems 1, 2+ and 3. Base for that is a network of EPH representatives which are well educated and acting also as regional auditors. This is more cost efficient and is reducing also the ecological impact.

The EPH is notified for the following product groups:

- Windows and doors (EN 14351-1)
- Floors and sports floors (EN 14041, EN 14342, EN 14904)
- Timber and wood-based materials (EN 13986, EN 14080, EN 14081-1, EN 14374, EN 15497, EN 16351)
- Wall and ceiling cladding, facades made from different materials (EN 438-7, EN 14915, EN 15102)
- Thermal insulation materials (EN 13162 to EN 13171)
- EADs 130005-00-0304 Solid Wood slab element, 190005-00-0402 terrace decking kit, 210058-00-0504 composite-based panels

Furthermore, the EPH has a horizontal accreditation for VOC emission tests according to EN 16516 and selected reaction to fire tests (EN ISO 1182, EN ISO 1716, EN ISO 9239-1, EN ISO 11925-2)

Recognized Body according to LBO

In the frame of the German law for construction products of the federal states (Landesbauordnung, LBO), the EPH is working in different fields:

- Testing laboratory for reaction to fire and VOC emission according to EN 16516 for underlay materials and coatings for floors
- As testing, surveillance and certification body in the frame of MVV TB for selected wood-based panels, nails, acoustic doors for interior use and industrial produced shuttering beams

Network of EPH representatives

VOC-emission of Building Products

General technical approvals/Voluntary DIBt expert opinion

Coatings, treatment materials and adhesives for wood floors and underlayments for laminate floor coverings and parquets require a general technical approval issued by the construction supervising authority (abZ). Basis for granting an approval is the MVV TB (Model Administrative Provisions - Technical Building Rules) with the "Requirements for building constructions regarding health protection" ABG - Annex 8.

Approval procedures – course of events

- Manufacturer/retailer apply for approval at DIBt
- DIBt confirms the application and notifies the data and information required for the product/product group (product description, material specification sheets)
- Applicant forwards data and information
- DIBt sets up test program
- Applicant arranges that tests are conducted at an approved testing body like EPH
- DIBt evaluates results and, after positive evaluation, grants approval issued by the construction supervising

Emission testing – AgBB-scheme/ABG

- Determination of the VOC- and SVOC-emission according to EN 16516 by means of examinations conducted by the respective chambers
- Product specific and emission dependent test with test period up to 28 days
- Evaluation of the results according to AgBB-scheme/ABG

Determination of Odour Emission of Building Products

DIN EN ISO 16000-28

In Germany, the evaluation of emissions from building products is based on the AgBB-scheme (AgBB: comittee for Health-related Evaluation of Building Products). Since its introduction in 2002, it has been foreseen to include a sensory assessment in this evaluation scheme. Therefore, a methodical approach for testing and assessment of odour emissions was developed within the last years which is the base of DIN EN ISO 16000-28:2012-12 (Indoor air – Part 28: Determination of odour emissions from building products using test chambers). Depending on the task different parameters such as perceived intensity, hedonic, or acceptance can be determined.

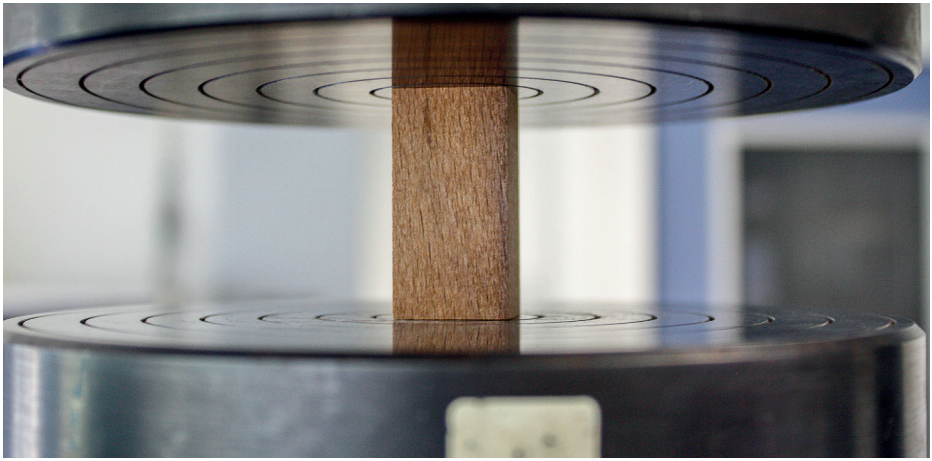
In the near future, the assessment of odour is intended to be included in the AgBB-scheme as well as in the awarding basis of the Blue Angel environmental label. Therefore this test will be combined with the determination of VOC and formaldehyde emissions.

In the framework of the Finnish M1 classification, odour acceptance is determined according to DIN EN ISO 16000-28 and assessed in accordance with the M1 requirements.

The (EPH) has the appropriate technical equipment and has established the test method in a special odour laboratory.

In the EPH, from a large number of employees a panel of 16 persons were trained and according to strict criteria as appropriate examiner selected.

Physical Tests on Wood and Wood-based Materials



Product areas and fields of activity

In the materials and product testing laboratory, which is accredited according to EN ISO/IEC 17025, numerous physical tests are carried out on wood and wood-based materials such as MDF, OSB, particleboard, plywood and solid wood panels for use as construction products and furniture. Type tests are offered for manufacturers and characteristic property values are determined to prove serviceability. Mechanical fasteners and adhesives are examined, and joints made from them are evaluated with regard to their strength.

The laboratory offers tests for thermal and moisture protection as well as tests to evaluate the sound insulation of floors and wall coverings.

Thermal and moisture protection tests

Testing of thermal conductivity and thermal resistance is carried out according to EN 12664 and EN 12667 in plate instruments. Further characteristic values important for the use of thermal insulation materials are determined, such as water absorption, behaviour under structural load and dimensional stability.

The basis for determining the water vapour diffusion resistance of diffusion-open and diffusion-inhibiting materials is EN ISO 12572.

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Mechanical tests

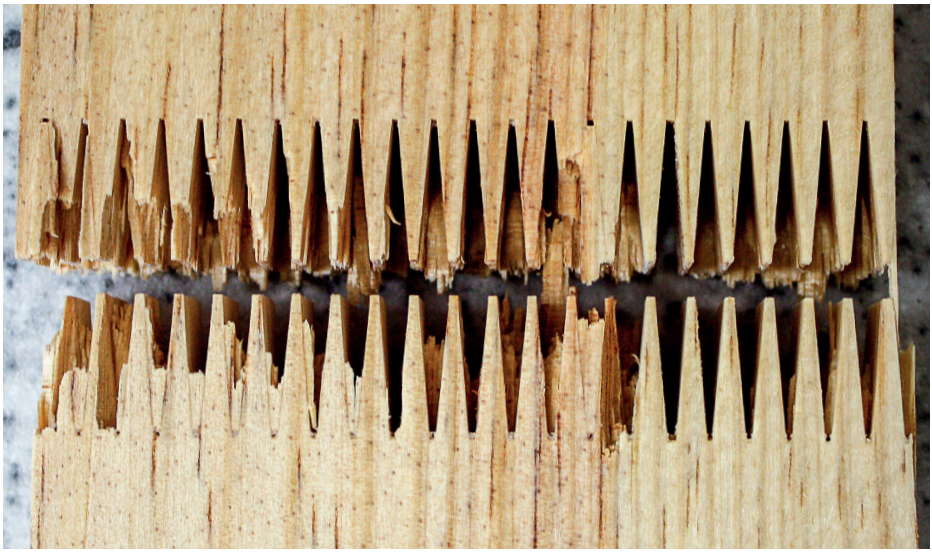
Strength and stiffness values are determined on wood and wood-based materials under bending, tensile and compressive stress. The long-term load-bearing behaviour and dimensional stability under moisture load are also examined, as is the behaviour under impact or alternating load.

The adhesive strength of adhesives for use in load-bearing and non-load-bearing areas as well as the performance characteristics of pin-shaped fasteners are tested in the laboratory area.

Numerous tests are also carried out on floor coverings, such as thickness swelling, joint strength, lifting strength and dimensional stability.

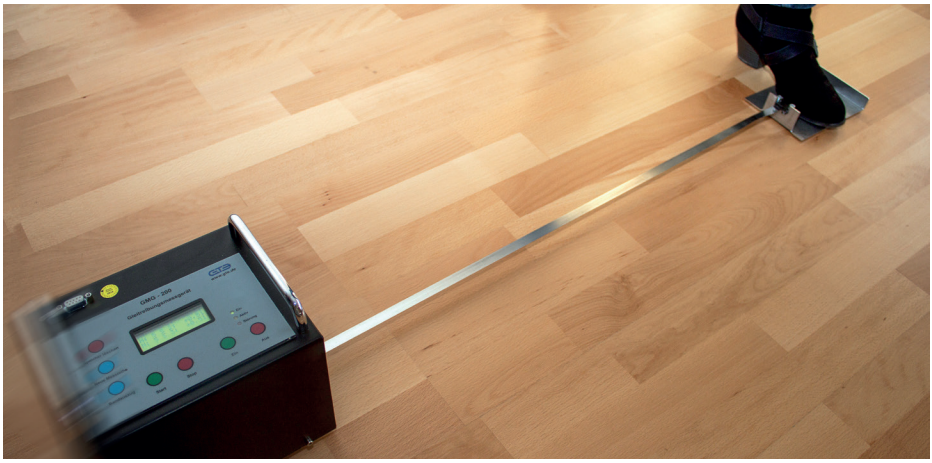
Sound tests

In the sound laboratory, the walking sound emission and the impact sound insulation of floating and glued floors as well as the influence of flooring underlays on these properties are examined.



Determination of tensile strength of finger joint connection

CE Declaration for Flooring/Sports Areas



Product fields and fields of activity

The Entwicklungs- und Prüflabor Holztechnologie GmbH (EPH) is mainly busy in the field of resilient, cork, MMF, laminate, parquet and wood floorings.

The EPH provides testing services as accredited test laboratory according to EN ISO 17025 and Notified Test laboratory. The EPH is IMO-accredited for floor coverings on ships. It also acts as testing and monitoring body for private labels (e.g. Blue Angel, M1, TÜV-PROFiCERT-product Interior, FloorScore). Furthermore, the EPH is a Notified Body (NB 0766) for certification of flooring with fire retardants in the AVCP system 1. Further business areas are development and distribution of equipment for floor testing and education in the frame of a training program for testing of floor coverings.

Fitness for use properties

EPH provides testing services for different fitness for use product standards, mainly for:

- Resilient floors (e.g. EN ISO 10581, EN ISO 10582, EN 12104)
- MMF-floors (e.g. EN 16511, EN ISO 20326)
- Laminate floors (e.g. EN 13329, ISO 14486)
- Parquet and wood floorings (e.g. EN 14354, EN 13489) .

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CE relevant properties

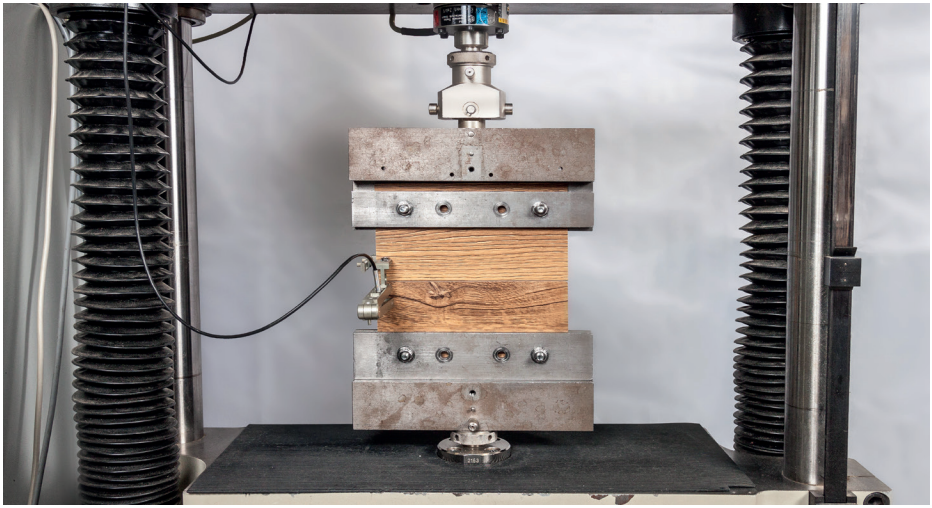
The following tests are performed in the frame of the harmonized standards EN 14041, EN 14342, EN 14904:

- Reaction to fire tests for the fire classes Afl to Efl
- Formaldehyde emission test according to EN 717-1
- PCP content determination according to CEN/TR 14823
- Slippery resistance test according to EN 13893 and CEN/TS 15676
- Thermal resistance according to EN 12664 and EN 12667
- Electrostatic behaviour according to EN 1815 and EN 1081
- Biological durability according to EN 335
- Breaking strength according to EN 1533

Further testing activities

Examples for further activities of the EPH are the determination of:

- VOC emissions e.g. for private labels like TÜV PROFiCERT product interior, Blue Angel
- Acoustic properties (walking, impact and airborne sound).
- Mechanical properties for underlays for laminate and MMF floor coverings (EN 16354, EPLF and MMFA bulletins)
- Content of dangerous substances (e.g Phthalates, heavy metals)
- Antibacterial and mould resistance
- Climate resistance for UPEC



Determination of locking strength of mechanical connection systems of flooring

EPH and TÜV PROFiCERT-product Interior Label

A Cooperation for an independent product label

1. What is TÜV PROFiCERT-product Interior?

TÜV PROFiCERT-product Interior is an independent quality label for products for interior use, concerning emission and optionally further quality features. The programme offers a strict separation of testing and surveillance from the certification procedure, taking divided between two independent companies. The TÜV PROFiCERT-product Interior brand is available as Standard and Premium variant.

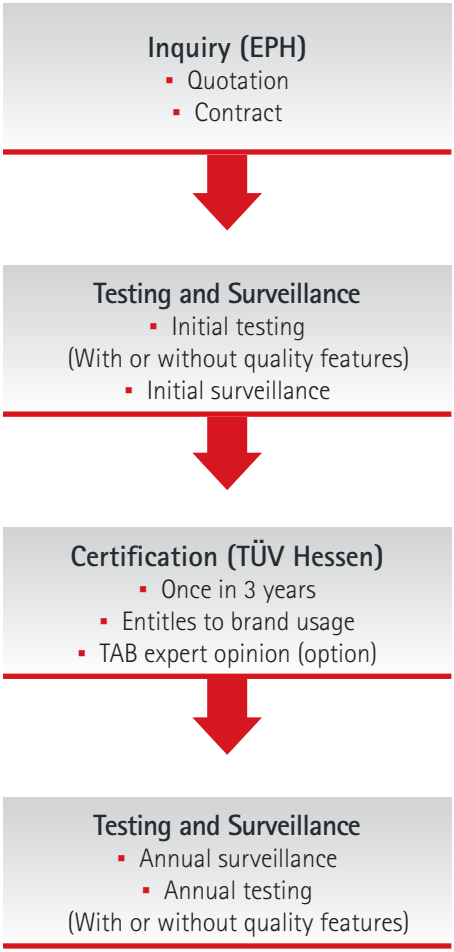
2. How does the cooperation between EPH and TÜV work?

Within the TÜV PROFiCERT-product Interior programme, EPH GmbH is – along with TFI Aachen GmbH – responsible for the testing and surveillance. The certification decision is made by TÜV Hessen on the basis of results of both testing and surveillance, in accordance with the criteria for the allocation of the TÜV PROFiCERT-product Interior brand.

3. For which products is the Label TÜV PROFiCERT-product Interior label available?

The TÜV PROFiCERT-product Interior label can be claimed for all interior products, e.g. floorings, wall or ceiling coverings, as well as wood based panels.

4. How do I get a TÜV PROFiCERT-product Interior label?



After having placed an inquiry for testing, surveillance and certification of your product(s) at EPH, we will ask you for the specification of the product features in order to form collections (if necessary). Subsequently you will receive a tailor-made quotation including all the features you are interested in. By signing the quotation, you place the order, and a contract between your company and EPH is closed.

Following this, the initial testing and surveillance of your product(s) is made. The results are sent to the Certification Body, which issues one or more certificates which are valid for three years.

The regular surveillance of the factory or factories, including sample drawing and testing, takes place at least once a year.

5. What does PREMIUM mean?

All products branded with the Standard TÜV PROFiCERT-product Interior label fulfil the criteria according to AgBB, CAM (Italy), French VOC-Emission Class A, Belgian Regulations on VOC emissions from construction products, LEED v4 as well as BREEAM International New Construction, General Level.

The PREMIUM label is available only for products which fulfil harsher criteria regarding the emissions. Following criteria are fulfilled in the PREMIUM-variant:

General criteria:

- AgBB, February 2015/AgBB 2018
- MVVTB, Annex 8 (ABG)
- Emissions Class A+ according to the French VOC Regulation „Décret n° 2011-321 du 23 mars 2011"
- Belgian Regulations on VOC emissions from construction products „8 MEI 2014. — Koninklijk besluit tot vaststelling van de drempelniveaus voor de emissies naar het binnenmilieu van bouwproducten voor bepaalde beoogde gebruiken"
- CAM Italy - „Minimum environmental criteria in the procurement of planning and work services for new buildings, renovation and maintenance of buildings and the management of public administration construction sites", CRITERI AMBIENTALI MINIMI PER L'AFFIDAMENTO DI SERVIZI DI PROGETTAZIONE E LAVORI PER LA NUOVA COSTRUZIONE, RISTRUTTURAZIONE E MANUTENZIONE DI EDIFICI PUBBLICI, decreto 11 ottobre 2017
- LEED v4 (outside North America; LEED v4 for BUILDING DESIGN AND CONSTRUCTION, April 5, 2016)
- BREEAM International New Construction 2016 (Technical Manual SD233 1.0), Exemplary Level
- Finnish M1-Classification for construction products, version 15.11.2017 (the criteria according acceptance and ammonia are not included, accept of ammonia emission from smoked oak parquet.)

In addition for parquet and wood flooring, laminate floor coverings, MMF floor coverings:

- DE-UZ 176 (Blue Angel), January 2013
- Austrian environmental label, guideline UZ 07, wood, wooden materials and wooden floor coverings, version 9.0, January 1, 2019

In addition for resilient floor coverings:

- DE-UZ 120 (not for PVC flooring), February 2011
- Austrian environmental label, guideline UZ 42, elastic floor coverings, version 4.0, January 1, 2019 (The requirements for odour are not included)

In addition for textile floor coverings:

- GUT/PRODIS (Gemeinschaft umweltfreundlicher Teppichboden e. V.) (The requirements for odour are not included.)
- DE-UZ 128 (Blue Angel) February 2016 (The requirements for odour are not included.)
- EU-Ecolabel for textile floorings (2009/967/EC)
- Austrian environmental label, guideline UZ 35, textile floor coverings, version 4.0, January 1, 2019 (The requirements for odour are not included.)

In addition for underlays for installation, flooring installation materials:

- Emicode EC1^{Plus}, 18.04.2018
- DE-UZ 113 (installation materials), June 2011
- DE-UZ 156 (flooring underlays), February 2011

In addition for coated and uncoated wood materials:

- DE-UZ 76 (Blue Angel)
- Austrian environmental label, guideline UZ 07, wood, wood-based materials and floor coverings made of wood, version 9.0, January 1, 2019

6. Is it possible to make changes in the certificate within a certification cycle?

Yes, you can apply for a change in your certificate (expansion/amendment, e.g. for changes in the product names) at EPH GmbH directly, which informs after checking the certification body TÜV Hessen.

7. Which quality features can be certified?

All features included in the product standards can be tested and certified. Please contact EPH for a detailed offer.

Test reports/certificates in the frame of TÜV PROFiCERT surveillance can be used for voluntary expert opinions as proof for fulfillment of requirements according to MVVTB (Annex 8, ABG). The TÜV PROFiCERT certification programme was accepted by an European TAB organisation which can issue this expert opinion.

Test Devices

Emissions test chamber

The determination of formaldehyde and VOC emissions from wood-based materials, construction products and furniture is a core competence of the EPH for many years.

As accredited test body for emission testing, the EPH provides not only professional know-how but also technical equipment in terms of emission test chambers and gas analysis systems.

These test systems are especially characterised by an easy operability and a layout adapted perfectly to customer`s needs as well as by an attractive price. Among others, the systems are established in the wood-based materials-, binder- and furniture industry and at testing institutes. Emission testings can be conducted according to several test procedures.

We are pleased to support you on your tasks, to validate your system by appropriate comparison tests and to train your laboratory staff.

System PK-ES (stainless steel)

- Interior volume 100 l/225 l/1 m^3
- Electrically polished interior
- Digital display and recording of test parameters temperature and rel. humidity; volume flow optional acc. to customer requirements

System PK-GS (glass)

- Interior volume 100 l and 225 l
- Digital display and recording of test parameters temperature and rel. humidity; volume flow optional according to customer requirements

Applications

- VOC and formaldehyde emission testing according to national and international standards

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Surface test devices

The test devices offered are based on test-methodological research of the IHD or long-term test practise of the EPH.

The impact resistance device for laminate floorings according to EN 17358 was developed together with EPLF in course of an IHD research project. The equipment for pollution resistance according to IHD-W-477 was developed by IHD in the EUROPARQUET-research topic for the testing of non-film forming coatings on wooden floors.

Determination of impact resistance acc. to EN 17368 for laminate floor coverings

Impact resistance test devices for floorings

- Impact resistance device according to EN 17368 for laminate floor coverings

Devices for testing of surface durability

- Test appliance for determining the pollution resistance acc. to IHD-W-477

Quality and Conformity Marks

- Conformity Mark (CE mark) European Notified Body

- EPH Quality Mark "Quality proven" with external surveillance

- TÜV PROFiCERT-product Interior

Publisher:

Last reviewed: April 2023

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