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PRODUCT GROUP PROFILES

Wood fiber insulation

compiled by

HOLZ VON HIER

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HOLZ VON HIER: non-profit initiative with stakeholder board, advisory boards, expert panel and open partner network.
HOLZ VON HIER: Climate and Environment Label / HvH Environmentalfootprint.

1 / Introduction

The insulation of old building stock is one of the central energy issues of our time. According to FIW 2012, most of the house walls in need of renovation are still single-wall masonry with a rather low insulation rate (in Germany for example only 24%). For the protection of climate and resources, however, the materialine used and its upstream chains are also of central importance. For buildings according to the current EnEV standard, the upstream chains of the materials and the construction of the building already have a greater share of the environmental impact than the entire utilization phase. The material flow along the processing chain also plays an important role in insulating materials. The environmental balance is also strongly influenced by the material of the insulation product. In principle, insulating materials can be distinguished according to the essential basic raw materials:

A. Insulation materials based on renewable raw materials:

- Wood insulation materials. Main part of NaWaRos. Mainly in the form of fiberboards, which are pressed in different processes (wet and dry process) from wood fibers. In addition, there are still wood wool lightweight panels that are cement-bound.
- Cellulose. Insulation of wood raw material or Alptpapier in the form of plates or blow-in insulation.
- Straw. Modern and very ecological insulation, very popular.
- Hemp. Natural fiber insulation in the form of sheets or mats.
- Flax. Further natural fiber insulation with good ecological properties.
- Seaweed. Rare insulation with a good ecobalance.
- Cork. Cork granulate insulation with character. Odor.
- Coconut fiber. Insulation with high transport load - rather not recommended.

B. insulating materials based on petroleum

- EPS (Styrofoam). Classic insulation from plates. Combustible.
- XPS. Foam boards, also combustible.
- PURE. Also foamed to soft or hard plates material.

C. Mineral insulation materials

- Glass wool. Most common insulation ever.
- Foam glass. Special insulation in the form of plates with very good technical characteristics.
- Rock wool. Energy-intensive production, good insulation effects, but sensitive to moisture.
- Calcium silicate. Insulation in sheet form with the best fire protection and strength properties. Expensive.
- Perlite. All-round insulation in the form of expanded beads for pouring.

D. ETICS - External thermal insulation composite systems

In addition, there are still thermal insulation systems that are mounted as complete facade elements. Decisive disadvantage is the catastrophic reusability and thus potentially high enviornmental footprint.

Market shares: insulating materials from renewable raw materials are still a rarity today. Mineral as well as glass and rock wool have the highest market shares of 54.6%, followed by synthetic insulation materials of 41.4% such as EPS, XPS, PUR, of which 30.7% EPS. Natural insulating materials have a market share of only 4% (including 32% cellulose, 28% soft fiber and 20% lightweight panels).

2 / Prechains

Basic raw materials in wood fiber insulating materials

Wood fiber insulation boards such as MDF, HDF, DHF, DFF boards consist of wood fibers 82-86%, water 5-7%, PMDI glue or UF glue (urea resin) 4-11%, paraffin emulsion <1%. In the case of coated plates, additives (for example melamine-formaldehyde resin) and optionally decorative papers are also added. Wood wool panels are made of wood 25-35%, burnt magnesium as binder 30-40% (or cement), magnesium sulphate 3-6%, water 30-40%.

For comparison

Basic materials in plastic insulation materials (EPS, XPS, PUR). EPS and XPS plastic insulation panels consist of the precursors polystyrene granules 90-95%, graphite 3.5-5% and additives such as pentane 4-7% (as propellant) and hexabromocyclododecane 9.5-3% (as flame retardant). PUR plastic insulation panels consist of methylene diphenyl diisocyanate (MDI) 55-65%, polyol 20-30%, additives such as pentane 4-5% (as blowing agent), foam stabilizers 0.5-2%, phosphorus-containing flame retardants 2-5% , Basic raw material for all is petroleum.

Basic raw materials for mineral, glass, rock wool. Mineral wool and glass wool consists of: broken pieces 50-70%, sand 10-15%, soda 5-15%, borate 4-8% (borate = ester of boric acid). Rock wool slabs consist of: dolomite and basalt 40-50%, cementitious shaped stones 45-55%, binder (phenol-formaldehyde resin) 4%, mineral oil 0.2%, adhesion promoter 0.1%.

Raw material extraction (A1)

The raw material wood comes from forests that are either commercial forests (the rule in Central Europe) or primeval forests (in other parts of the world). German forests have been sustainably managed for centuries, sustainable forestry is enshrined in the Forest Act. Almost all of our managed forest areas are additionally certified with sustainability labels for the forest (FSC and PEFC). This is not the case everywhere in the world, for example in Asia, Latin America and Africa only about 1-5% of the forest area is certified with such sustainability labels. For imports without such a forest label, depending on the country of origin, the risk of depletion is high. The proof of origin of the climate and environmental label HOLZ VON HERE is conform to the due diligence. An entry requirement for logs in the HOLZ VON HIER proof of material flow is that the wood originates from sustainable forestry (certified with FM certificate from FSC, PEFC or similar).

Wood is a renewable raw material and thus is available in principle permanently, provided it comes from sustainable forestry, because then no more wood is taken than grows back. Timber from poaching should not be used for climate and environmental reasons (the „outreach“ depends on the occurrence in primary forest countries, especially in the tropics such as Asia, Latin America, Africa and boreal forest areas such as Siberia, Canada etc.).

For comparison

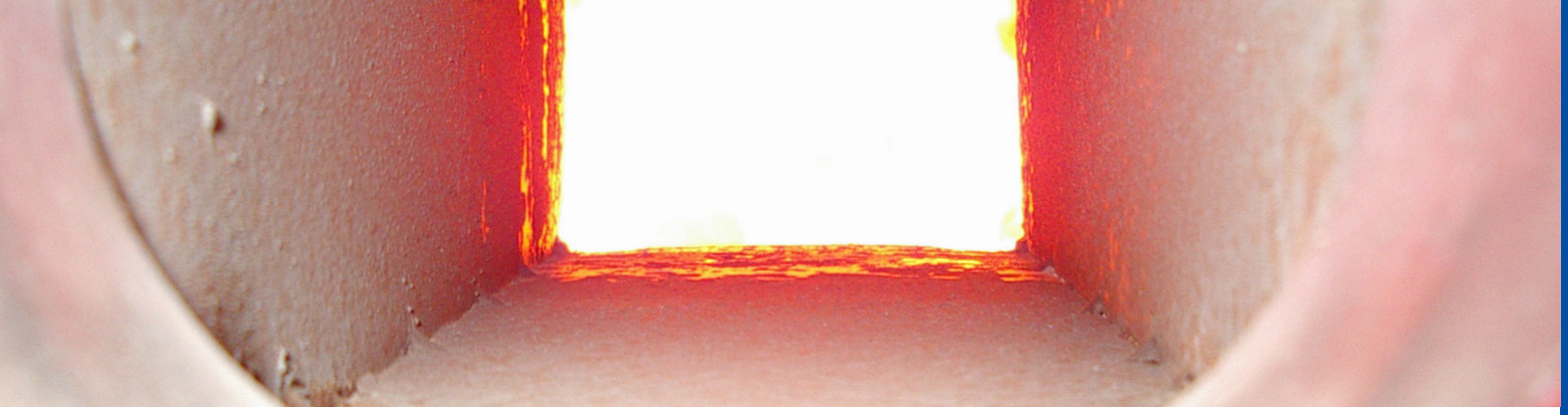
Plastic insulation materials (EPS, XPS, PUR). (1) EPS, XPS. Oil becomes benzene, which is converted to ethylbenzene, to styrene, to polystyrene (PS) and to the precursor PS granules. This is the precursor for all polystyrene based products.
(2) PUR. Oil is processed through various steps to the precursor PUR granulate.
OIL. The main oil deposits in Saudi Arabia are 14%, Russia 13%, USA 11% and China 5%. The range of oil is given at about 100 years (USGS). GRANULES. Polystyrene granules is v.a. Made in Asia and traded worldwide. GRAPHITE. Graphite is mined in 15 countries with commercially exploitable potential. In Europe there are only a few active graphite mines (for example Ukraine, Norway, Czech Republic, Austria). The world's main resources are 68% in China, 14% in India and 10% in Brazil. The range of graphite at current economic production rate is very contradictory.

Mineral-, Glas-, Steinwolle. (1) GLASS. In German 2 million tonnes of recycled glass are collected annually (recycling rate 85%). (2) SODA. Soda is produced in 28 countries worldwide, the three largest producers are China 46%, USA 21% and Russia 6%, Germany has only 5% of world production. (3) BORATES. Borates are mined in 9 countries, the three largest producers are Turkey 46%, Chile 16% and Argentina 14%, Germany has no own deposits. (4) STONE. Stones such as dolomite and basalt are classified as ubiquitous. Recycled glass is available in most countries. The range of soda is given as >> 100 years, borates at 57 years, stones as >> 100 years (USGS).

Transports „cradle to gate" (A2) and Transports „gate to customer" (A4)

Transports in the processing chain (A2). As a rule, barely reliable information is available on transports within the processing chain. In the case of insulating materials here is the primary product usually not roundwood but sawdust and wood chips or chips from industry. In product-independent EPD, standard data sets of 50 to 350 km for the upstream chains are usually used. Some studies even expect only 75-200 km (IBU) to 562 km (Thünen Institute). But even values of 500 to 600 km probably underestimate the real flow of goods, considering the imports of wood fibers and waste wood to Germany. In principle, all raw materials for wood fiber insulating materials could be obtained within a short time, unlike, for example, oil-based plastic insulating materials. However, with 750,000 tons of wood chips and 1.7 million tons of residual wood, considerable quantities of primary products for insulating materials are also imported to Germany each year. In total, 1.7 million tonnes would be avoidable for these primary products as imports and exports overlap. 90% of the traded HS would be avoidable and 50% of the traded residual wood. By closing cycles, around 170,000 tonnes of CO_2 could be avoided each year. Add to that the ...

Transport to the place of use (A4). Transports A4 are not recorded in EPD, but can account for a large part of the life cycle assessment of the building material. This is particularly important when producing certain products from manufacturers located in different parts of the world. You can not look at the product from where it came from. After Germany, a considerable amount of insulating materials are also imported each year, namely 16,620 tonnes of wood fiber, 19,000 tonnes of glass, 133,693 rockwool insulation and 151,271 tonnes of polystyrene (2016). Without proofs of origin such as HOLZ VON HIER, products used in construction and interior design can have covered thousands of kilometers of transport, even though the raw material itself would be very regional.



For comparison plastic insulating materials and mineral insulating materials

Standard data sets from life cycle assessments (EPD) also expect plastic and mineral insulating materials with standard data sets of 50 to 350 km for the entire upstream chains. This can not be realistic just because of the basic raw materials described in these products. Again, the importance of transport for the life cycle assessment is greatly underestimated. Without material flow certificates, products used in construction and interior design can have covered thousands of transport kilometers. This should be demonstrated by means of material flow indices.

- Example basic raw oil. Germany has 0.1% of world oil reserves, and the transport of this basic raw material of all plastic products is correspondingly high.
- Example plastic precursors. All precursors and intermediates up to plastic granulates and above all the plastic granules themselves have worldwide material flows (China has about 50% market share). For example, annual imports to Germany: polymers of styrene 1 mln t, propylene 1.6 mln t and ethylene: 2.5 mln t.
- Example additive such as graphite. Germany does not have its own graphite deposits and needs to import its needs, about 44,000 tonnes a year (for example, from China, India, Brazil).
- Example of plastic insulation itself. Plastic insulation materials have worldwide material flows.
- Example broken glass. In Germany, 2 million t annually. Recycled glass collected with transports throughout Germany, but it is also imported waste glass.
- Example soda. Germany has 5% of world production, but soda is also imported.
- Example Borates. Germany has no own deposits and imports > 80,000 t of borates per year (eg Turkey, Chile, Argentina).
- Example stones. Germany itself mines stones in quarries, but every year, e.g. also about 0.72 - 1 million tons of dolomite and other stones imported to Germany.
- Example mineral / rock wool. Mineral / rock wool is produced in Germany, but annually also about 1 million t of glass wool and 0.24 million t of rock wool are imported to Germany.

Production (A3)

Wood fiber insulation materials require significantly less energy in production (9 MJ/kg) than mineral wool (27 MJ/kg) or plastic insulating materials (77 MJ/kg) with a comparable insulation effect (FWI, 2012). The thicker the insulation material required to comply with the EnEV must be, the more energy is needed in production. Wood fiber insulation panels cause CO_2 emissions in the production of approx. 50 kg/m³ of insulation material, mineral wool insulation materials between 100 - 200 kg/m³ and plastic insulation materials between 50 and 200 kg/ m³.

3 / Use phase and after use phase

Use Phase (B)

Ilnertness of the building material. Wood fiber insulating materials are inert during the use phase and, as building materials themselves, do not consume energy, water or raw materials. Your climate and environmental parameters are set to zero in this phase (GWP, AP, EP, ODO, POCP, PERE, PENRE, water = 0).

Aftre use phase (D)

Wood-based insulation materials are also end-of-use resource-efficient and ecological.

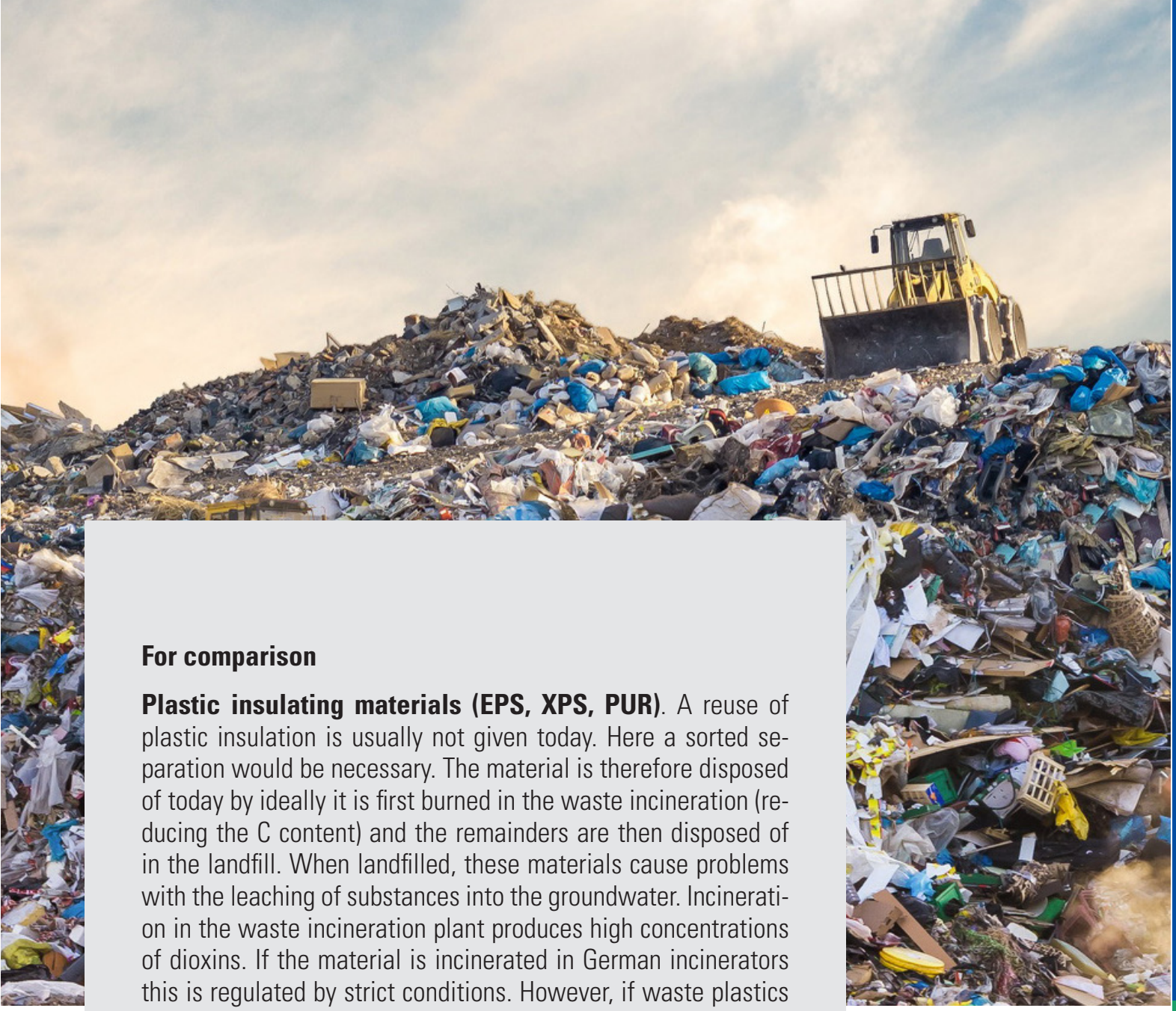
The reusability of building materials depends on the one hand on the product itself, on the other hand, but also on the context in which it is installed. When timber construction is the dismantling, the sorted disposal or recycling loosely installed insulation materials (blown, poured, as mats or plates, for example cellulose, hemp, wood fiber) is usually feasible without major problems! This favors in principle the more ecological version of the reuse.

Depending on the material (in order of decreasing environmental and resource conservation), reuse, composting, recycling, incineration and landfilling are common for the disposal of the insulation materials. The disposal of various materials is due to currently low waste quantities not yet possible in the industrial style (for example, in ETICS) or practice.

Untreated wooden insulating materials can in principle be reused or recycled. One exception is wood-wool insulation panels, the usual method of subsequent use today being landfilling or thermal recycling in the incinerator. The possible or common recycling routes are shown in the following table.

After use of insulatiing materials	Reuse	Composting	Recycling	Incineration	Landfilling
Fiberboard	x	-	x	x	o
Blow-in cellulose	-	-	-	x	o
straw	(x)	x	-	x	o
hemp	x	x	-	x	o
flax	x	x	-	x	o
seagrass	-	x	-	x	o
cork	-	x	(x)	x	o
EPS	-	-	x	x!	o
XPS	-	-	x	x	o
PURE	-	-	x	x	o
glass wool	-	-	-	-	x
rock wool	-	-	(x)	-	x
foam glass	-	-	(x)	-	x
Perlites	-	-	-	-	x
calcium silicate	-	-	(x)	-	x
ETICS	-	-	-	x	x?

x = usual way of recycling (with sorted separation!)
(x) = theoretically possible recovery route
o = possible, but not a priority recycling method



For comparison

Plastic insulating materials (EPS, XPS, PUR). A reuse of plastic insulation is usually not given today. Here a sorted separation would be necessary. The material is therefore disposed of today by ideally it is first burned in the waste incineration (reducing the C content) and the remainders are then disposed of in the landfill. When landfilled, these materials cause problems with the leaching of substances into the groundwater. Incineration in the waste incineration plant produces high concentrations of dioxins. If the material is incinerated in German incinerators this is regulated by strict conditions. However, if waste plastics are exported as waste to countries that have less stringent environmental regulations, this results in high environmental and health burdens on thermal disposal. Recycling and reuse of plastic insulating materials is difficult, economically not yet possible today, due to the additives used often in the disposal and recycling of health and environmental critical and innovative processes are located in the field of basic research.

Mineral, glass, rock wool. Disposal on rubble dumps is today the main route for mineral wool after the end of the use phase. Reuse for the same insulation is excluded for mineral, glass, rock wool. Recycling would be theoretically possible but only with purity and even then a use for the same product would not be possible but only a downcycling as an additive for fiber cement boards, roof tiles and bricks or concrete.

4 / Product features

Insulation effect and climate protection

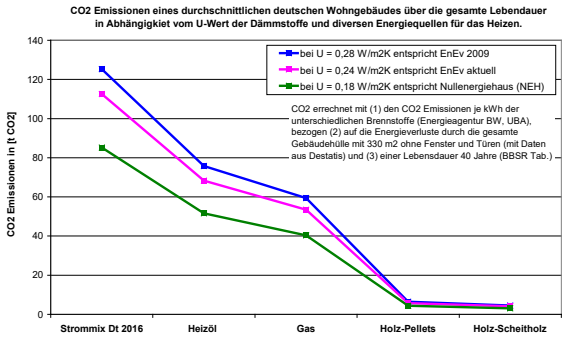
Lambda values and climate protection. A central parameter for the selection or assessment of insulating materials is the thermal insulation (lambda values). The lambda values of most of today's insulation materials are comparable, with lambda values of 0.03 - 0.045 W/mK (= 0.9 - 1.35 W/m^2 or 0.022 - 0.032 kWh/m^2 energy loss per day or 0.012 - 0.017 kg CO_2/m^2 wall surface). Possible further improvement potentials through insulation innovations achieve a certain saturation.

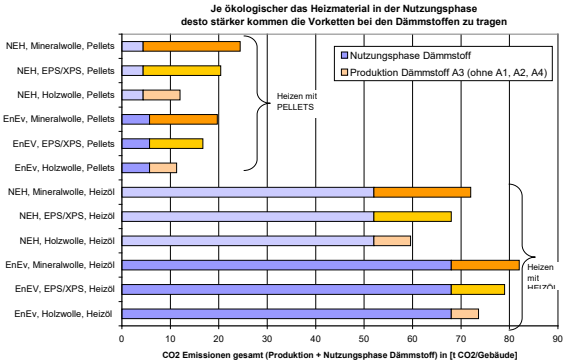
Heat storage capacity (Q) and climate protection. But not only the lambda value is important (for example, the most energy promotions and rules stop it, for example German EnEV) but also the heat storage capacity (Q) of the building materials is important. The higher the heat storage capacity, the greater the buffer effect and the summer thermal protection. Wood wool insulation has a 5 times higher Q than glass wool of the same thickness. Rooms behind wood insulation cool off less quickly at night when the heating is switched off. That saves energy.

Insulation has great potential for energy savings in renovation projects. The theoretical annual energy requirement for heating has fallen since 1977 to 90 kWh/m^2*year (EnEv 2009) due to improved insulation requirements of approx. 300 kWh/m^2*year (WSchVO 1977). This represents a huge improvement if legal requirements for insulation in renovation work. In the implementation of the requirements are the greatest potential savings.

In new buildings (with generally good insulating materials), however, it depends on the type of energy source. Especially in the case of new buildings, the type of energy sources during the usage phase is more important than the lambda value of the modern insulation materials used here.

Wood from short distances from sustainable sources offers enormous savings potential here. CO_2 emissions due to energy loss in the use phase (40 y., BBSR) also depend to a significant extent on the heating material. Wood pellets of short distances instead of heating oil improve these values more than if the insulation material has a U-value according to EnEv (0.24 W/m^2*K) or zero-energy house ZEH (0.18 W/m^2*K).





Health aspects

Health aspects of wood fiber insulating materials. A potential endangerment of climate, water, environment and health can not be caused by the basic material itself but only by „additives" in the insulating materials. In the case of wood fiber insulation additives are mainly flame retardants. There are basically two different substances here:

a) Soda / ammonium phosphate. This is the safest option for the environment and health.

b) Borates. Although borates have now been included in the list of candidates for REACH (see REACH), their use in Germany has not yet been banned. However, products containing borates should be avoided as they are classified as toxic to reproduction.

Further health-relevant emissions of wood fiber insulating materials and insulation boards can only come from the binders or hardeners used. Wood insulation materials produced in Germany comply with the legal requirements for formaldehyde, VOC and eluates.

REACH-RISK in wood fiber insulation materials. There is a low risk of dangerous substances in the plates during German and European production. However, some substances which are also added to natural fiber insulation materials are affected, for example polyurethane-containing adhesives in the case of wood fiber boards in the dry process or borates in the case of cellulose insulation materials, wood fiber products, hemp products or flax products. However, import plates from other parts of the world may contain other significantly more toxic glues and so on. For plates, it is therefore always useful to pay attention to the German or European origin, or to a proof of origin such as HOLZ VON HIER.

For comparison

Plastic insulating materials (EPS, XPS, PUR). Plastic insulation produced in Germany complies with the legal requirements for formaldehyde, VOC and eluates. Values from EPD: (1) formaldehyde: undetectable; (2) VOC: TVOC-28 days: <50 - 100 µg/m³, SVOC-28 days: <5 - 10 µg/m³, VOC or NIK-28 days <5 - 10 µg/m³; (3) eluates are classified as „not relevant", presumably because the material is expected to be disposed of by incineration; (4) Carcinogens: no information provided.

Mineral, glass, rock wool. Mineral wool or glass wool insulation produced in Germany complies with the legal requirements for formaldehydes, VOCs and eluates (measured values from EPD are eg (1) formaldehyde (28-day values): <0.01 mg/m³ (for interior fittings) to 0.12 mg/m³ (facades). (2) VOC (28-day values): TVOC <1 mg/m³, SVOC 0.02 to <0.1 mg/m³, VOCo.NIK: <0.05 mg/m³; (3) eluates: no values, (4) carcinogenic (3-day values): <0.01 mg/m³, it is noted „no evidence is required in the product" especially not „for the outdoor application „). As binders, however, health-threatening phenol-formaldehyde resins are generally used.

For comparison

Plastic insulating materials (EPS, XPS, PUR). Plastic insulating materials could potentially contain substances that are hazardous to health, as the „Plastics" material sector contains 5 substances of the REACH regulation and 41 substances of the REACH candidate list. Plastic products sometimes contain high concentrations of plasticizers, stabilizers, pigments, flame retardants and other additives. According to the REACH regulation, 2 substances are already subject to limit values within the EU for plasticizers and 13 are on the REACH candidate list, for flame retardants they are 5 substances, for stabilizers 2 and for propellants 1 on the REACH candidate list. PUR polyurethane resins are synthesized from isocyanates, here v. a. MDI and PMDI use: MDI (methylene diphenyl isocyanate), PMDI (polymeric diphenylmethane diisocyanate), HDI (hexamethylene diisocyanate), TDI (tolylene diisocyanate), NDI (naphthylene diisocyanate), IPDI (isophorone diisocyanate), H12MDI (4,4-diisocyanatodicyclohexylmethane.) Almost all isocyanates can cause allergies and are suspected of causing cancer, but when polyurethanes are fully reacted and no longer contain any monomers, they are generally no longer harmful to health, but PUR contains 50-55% MDI and MDI is carcinogenic to EC Category 3 Polystyrene products such as EPS and XPS contain 0.5-5% additives including flame retardants such as HexaBromCycloDodecane (HBCD) HBCD has been banned worldwide since 2014 with exemptions in some states and is considered to be highly carcinogenic and over 1 mg/kg banned in the product in the EU Brominated flame retardants such as HBCD are likely to be obtained only in small quantities from unbesc damaged foamed polystyrene into the environment, but measurements are not available. But HBCD can hardly be degraded in the environment even in the lowest doses and accumulates in breast milk and in the blood. It is hardly degradable and toxic to aquatic organisms and probably accumulates in groundwater and thus in drinking water. The Federal Environment Agency recommends to refrain from products containing HBCD or the generally critical flame retardants.

Mineral, glass, rock wool. In the field of glass fiber insulating materials there are potentially 13 substances in the REACH candidate list in the glass plus any substances from adhesion promoters. It is not clear from EPD whether and how many REACH substances are present in mineral insulating materials. In rock wool probably less. In addition, however, the coarse fibers of mineral wool (> 3 µm) on skin contact lead to skin irritation and the fiber dust is classified as „potentially carcinogenic" (see Technical Rule for Hazardous Substances TRGS 521 and Hazardous Substances Ordinance GefStoffV). Mineral wool may, for example, only be sold or distributed in Germany if it has at least one of the following properties: the carcinogenicity index must be ≥40, the filament diameter must be> 3 µm (ie not respirable) or evidence of sufficiently high biosolubility must be available.

Safty aspects

Safety and behavior in case of fire of wood fiber insulation materials. Wood insulating materials are classified according to DIN usually in the fire class B1 (flame retardant). In this case, it is decisive for the safety in case of fire that building materials according to B1 are considered extinguishing, while for building materials B2 and below the fire itself is retained, even if the cause of the fire does not occur (for example dripping on burning of plastics). In wood fires, a charring layer forms, which inhibits rapid burning in the event of a fire and thus the spread of the fire.

In case of fire, wood insulating materials have a significantly lower smoke emission than other insulation materials. Cemented wood panels with cement are even less flammable, but should not be used indoors for health reasons.

For comparison

Plastic insulating materials (EPS, XPS, PUR). In the event of fire, all plastics, including plastic insulating materials, even if they contain flame retardant additives, are extremely dangerous to fire. According to fire protection experts, most people in house fires do not die from falling parts, but from toxic fire gases. In case of plastic fires, high emissions of harmful gases can occur. In the event of a fire, plastic products melt, also burn, and even small fires spread very quickly. This can lead to fire spread by secondary fires. Dripping burning plastics are difficult to extinguish. Insulating materials made of plastics can therefore result in a significant increase in the relevant fire load. In the event of a fire, very dense, smoldering smoke is created, which can significantly hinder orientation and thus escape speed, especially in buildings with groups of people who are difficult to orient and organize themselves (eg schools, kindergardens, retirement homes, hospitals). In addition to carbon monoxide, carbon dioxide, nitrogen oxides also hydrogen chloride, dioxins and possibly aromatics (such as Pyrene, Chrysene) are highly toxic and carcinogenic. Another hazard is derived from heavy metal containing stabilizers (e.g., lead). Bromine-containing flame retardants (e.g., HBCD) break down toxic bromine-containing gases upon combustion and can produce highly toxic dibenzodioxins and dibenuzofurans.

Mineral, glass, rock wool. Mineral wool is generally classified as non-flammable. At high temperatures, however, the glass fibers may melt. Mineral / glass wool has a temperature resistance up to 700 ° C. Rock wool has a temperature resistance up to 1000 ° C.

Lifetime

Durability. The durability of insulation materials of all kinds (including plastic insulation materials and mineral insulating materials) is given as follows according to BBSR: as foams / felts / blown in:> 50 years, as plates: 40 years. Hereby the BBSR sees no material difference in the durability.

Durability, care, repair-friendliness of wood fiber insulation materials. Wood fiber insulating materials are comparatively easy and non-hazardous at defective locations. Care in the sense is not necessary, but the insulation materials should be installed protected against moisture. A repair is not possible with wood fiber cement boards, the plate is replaced in case of defect as a whole.

For comparison

Plastic insulating materials (EPS, XPS, PUR). Plastic insulating materials are sometimes very susceptible to mechanical injury and can not be repaired if damaged.

Mineral, glass, rock wool. The durability of mineral wool is good. With properly used mineral / rock wool, no care is necessary. Defective parts can be easily removed and replaced.

5 / Environmental label

Environmental / quality label

HOLZ VON HIER (LOW CARBON TIMBER)

The HOLZ VON HIER label particularly distinguishes climate-friendly and environmentally friendly wood products with wood from the short routes of sustainable forest management, with proof of origin and life cycle assessment data. In addition, products manufactured in their entire material flow in Germany or Europe comply with the strict environmental and health regulations. HOLZ VON HIER is an environmental and environmental label and therefore has not developed its own criteria for sustainable forestry, but requires evidence such as FM certificates to FSC or PEFC or similar. Wood from Here is particularly important for hardwood floors.

FSC

FSC-FM certification certifies sustainable forest management worldwide according to the criteria of FSC. The wood in products with an FSC-CoC certificate can exhibit long transports.

PEFC

PEFC-FM certification certifies sustainable forest management worldwide according to the criteria of PEFC. The wood in products with a PEFC-CoC certificate can exhibit long transports.

Nature Plus

Imported and European-made goods with the label NATURE Plus have significantly lower formaldehyde values and VOC values than allowed by the EU limit. Attention is paid to compliance with the REACH regulation and attention is paid to substances on the REACH candidate list.

Blauer Engel (Blue Angel)

For thermal insulation systems and interior insulation.

EU flower

Not yet awarded for wood products.