



In my capacity as a publicly appointed and sworn translator for the English language for Baden-Wuerttemberg, I hereby certify this translation from the German document presented to me to be correct and complete to the best of my knowledge and belief. A copy of the German document is attached.

Tübingen, 14th July 2022



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ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804+A2

| | |
|--------------------------|--|
| Owner of the declaration | Bundesverband der Deutschen Ziegelindustrie e.V. |
| Publisher | Institut Bauen und Umwelt e.V. (IBU) |
| Programme holder | Institut Bauen und Umwelt e.V. (IBU) |
| Declaration number | EPD-BDZ-20210071-ICG1-DE |
| Issue date | 04/08/2021 |
| Valid to | 03/08/2026 |

Clay blocks (filled with insulation)

**Bundesverband der Deutschen
Ziegelindustrie e.V.**

www.ibu-epd.com | <https://epd-online.com>



1. General information

Bundesverband der Deutschen Ziegelindustrie e.V.

Programme holder
IBU – Institut Bauen und Umwelt e.V.
Panoramastrasse 1
10178 Berlin
Germany

Declaration number
EPD-BDZ-20210071-ICG1-DE

This declaration is based on the following product category rules:
Clay blocks, 11/2017
(PCR tested and approved by the independent advisory board (SVR))

Issue date
04/08/2021

Valid to
03/08/2026

Clay blocks (filled with insulation)

Owner of the declaration
Bundesverband der Deutschen Ziegelindustrie e.V.
Reinhardtstrasse 12-16
10117 Berlin
Germany

Declared product/declared unit
1 m³ clay blocks (filled with insulation)

Scope of application:
The scope of application of this document is limited to filled clay blocks which are manufactured in Germany by member companies of the Bundesverband der Deutschen Ziegelindustrie e.V., the German interest group for block manufacturers. Data from 2019 was provided by 17 member companies for this declaration. These members represent 90% by number of the manufacturers of filled clay blocks amalgamated in the Bundesverband der Deutschen Ziegelindustrie e.V. The product volume of these companies is some 90% of the German market by production quantity.
The underlying clay block is based on an EPD in which 20 member companies of the Bundesverband der Deutschen Ziegelindustrie e.V. were involved.

The owner of the declaration is liable for the basic information and supporting evidence; any liability of the IBU in relation to manufacturer's information, LCA data and supporting evidence is excluded. This document is a translation from German to English. It is based on the original declaration number EPD-BSW-20210266-CBA1-DE.

This EPD was compiled in accordance with the requirements of EN 15804+A2. In the following the standard is referred to more simply as EN 15804.

Verification

The European EN 15804 standard serves as the core PCR

Independent verification of the declaration and statements by an independent body in accordance with ISO 14025:2010

internal external

Dr. Eva Schmincke,
independent verifier

Hans Peters

Dipl. Ing. Hans Peters
(President of Institut Bauen und Umwelt e.V.)

Alexander Röder

Dr. Alexander Röder
(Executive Director Institut Bauen und Umwelt e.V.)

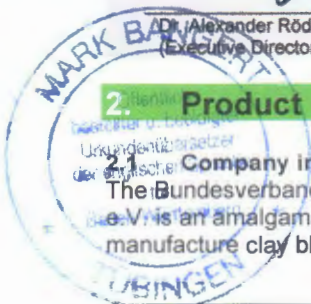
E. Schmincke

2. Product

2.1 Company information

The Bundesverband der Deutschen Ziegelindustrie e.V. is an amalgamation of companies which manufacture clay blocks. Data from plants which

manufacture unfilled clay blocks was analysed for this EPD.



2.2 Product description/Product definition

Clay blocks are a building product made of fired clay. They can be filled with perlite, mineral wool cuttings, mineral wool pads, wood shavings or polystyrene. Clay blocks filled with insulation are used in the exterior walls of buildings. There is a separate EPD for unfilled clay blocks. The figures in this EPD relate to averagely filled blocks whereby the filling represents an average mix of all filling materials specified. The basis of the LCA results in this EPD is the formation of an average for all German plants which was done as a weighted average in relation to the share of the individual production plants in the total annual production. A clay block with a bulk mass of 605 kg/m³ was selected as a representative product.

EU Regulation no. 305/2011 (CPR) applies for putting the product on the market in the EU/EFTA (with the exception of Switzerland). The product requires a declaration of performance including *DIN EN 771-1:2015-11 - Specification for masonry units - Part 1: Clay masonry units* and CE labelling

The respective national regulations apply to use, for example in Germany

- *DIN 20000-401*,
- The Model Administrative Provisions of the Technical Building Regulations (*MVV TB*),
- General building supervisory approval from the German Institute for Construction Technology of the respective manufacturer,
- The respective manufacturer's general building type approval from the German Institute for Construction Technology,
- Internal and external monitoring of products with general building supervisory approval and/or general type approval of the respective manufacturer.

2.3 Application

Clay blocks filled with insulation are generally used for the load-bearing exterior walls of buildings due to their excellent insulation properties. Filled façade elements are used as facing formwork for exterior walls or as interior insulation in old buildings.

2.4 Technical data

Relevant civil engineering data

| Name | Figures for a representative product | Figures for the entire product portfolio | Unit |
|---|--------------------------------------|--|-------------------|
| Compressive strength in accordance with <i>DIN EN 772-1</i> | 6-12 | 6-18 | N/mm ² |
| Bulk density in accordance with <i>DIN EN 772-13</i> | 605 | 550-900 | kg/m ³ |
| Thermal conductivity strength in accordance with <i>DIN EN 1745</i> | 0.07-0.08 | 0.06-0.12 | W/(mK) |
| Balancing humidity at 23 °C, 80% after <i>DIN EN 4108-4</i> | 0.5 | 0.5-1.5 | Mass % |
| Water vapour diffusion resistance level in accordance with <i>EN 4108-4</i> | 5/10 | 5/10 | - |

Product performance values in accordance with *DIN 20000-401*

- The Model Administrative Provisions of the Technical Building Regulations (*MVV TB*)
- The respective manufacturer's general building supervisory approval from the German Institute for Construction Technology
- The respective manufacturer's general building type approval from the German Institute for Construction Technology
- Internal and external monitoring of products

with general building supervisory approval and/or the general type approval of the respective manufacturer

2.5 Delivery status

Geometrical Data

Clay blocks filled with insulation are available in various formats and sizes depending on where they are to be used. The various dimensions are regulated in the respective manufacturers' approval notices from the German Institute for Building Technology (DIBt).

2.6 Base materials/ancillary materials

Clay blocks consist of the basic material of clay (more than 90%) and mineral additives (around 4%). The chambers of filled clay blocks are filled with perlite, mineral wool cuttings, mineral wool pads, polystyrene or wood shavings. The percentage by weight of the chamber filling is in the mid-single digit range.

Clay:

Untreated earths of various natural mineralogical compositions (aluminium oxide Al₂O₃, silicon dioxide SiO₂, iron(III) oxide Fe₂O₃). The raw materials are mined close to the surface in selected deposits.

Other natural clay ingredients:

Clays contain geologically deposited natural components in fluctuating quantities such as colour-giving iron oxide. Yellow to dark red firing colours can occur depending on the clay deposits. Clays can also contain chalk and dolomite.

Perlite:

A natural material which originated from submarine volcanic activity. After grinding and heating to 1000 °C, the perlite swells up to 15-20 times its original volume. The perlite in the filled clay blocks is water-repellent (hydrophobised).

Mineral wool pads:

These are tailor-made mineral wool panels exclusively made of approved fibres which comply with the conformity criteria of the Gütegemeinschaft Mineralwolle e.V. (RAL)'s quality and test specifications.

Mineral wool granulate:

Mineral wool granulate.

Polystyrene:

A petroleum product.

Wood shavings:

Free-flowing wood shavings from FSC-certified softwood.

Sand:

Is added as a filler with extremely soft (fine-grained) clay to balance the natural fluctuations of the mineralogical composition of the raw clay.

Auxiliary materials: Porosity agents:

Additional porosification is necessary when manufacturing highly insulating blocks. This porosification is achieved by adding polystyrene balls and/or fine cellulose fibres such as untreated sawdust or paper fibres. Suppliers are sawmills and the paper

industry.

SVHC:

Does the product contain materials from the ECHA (REACH) list of materials which are especially problematic for approval: Substances of Very High Concern – SVHC (Date: 01/02/2021) above a mass % of 0.1: **no**.

CMR substances:

Does the product contain further Category 1A or 1B CMR materials which are not on the candidate list at a mass % concentration of above 0.1 in at least one partial product: **no**.

Biocides:

Were biocidal products added to this building product or was it treated with biocidal products (is this therefore a processed product in terms of EU Biocide Product Directive no. 528/2012): **no**.

2.7 Manufacturing

After the clay has been open-cast mined it is transported to the manufacturing site for interim storage. The mechanical processing of the clays such as grinding and mixing is done in pan grinders and rolling mills. The aforementioned basic materials are crushed in certain optimised ratios (prepared), mixed and dampened. They are then stored in the soaking house. Porosification material is added before or after storage in the soaking house. After having passed through the fine grinding mill and the addition of water the blanks are shaped by extrusion presses with corresponding mouthpieces and downstream separator.

The material thus shaped enters the dryer which is mainly operated with waste heat from the tunnel furnace. The drying time varies depending on the format and bulk density and is generally 24 hours. Afterwards, the dried blanks are fired at approximately 1000°C in the tunnel furnace within a maximum of 24 hours. The firing of the porosification materials causes fine porosification. Clay blocks are ground level to produce plane blocks. The blocks are stacked, wrapped in recyclable polyethylene (PE) foil or strapped with polyester or steel belts. The energy requirement for clay block manufacture mainly involves the firing and drying processes. The electrical energy is mainly used in processing.

Perlite filling:

The expanded perlite is stored temporarily in large silos after delivery to the plant. For filling, it is drawn off from the silos and mixed with a water-based binding agent. The perlite is filled into the rough clay blocks by a feeder and compacted. The blocks filled with hydrophobised perlite then pass through two stages in which the upper and lower sides of the filled blocks are recompressed, hardened and cleaned. The filled blocks then pass through a dryer. The insulation filling is dried at a temperature of approximately 120°C.

Mineral wool pad filling:

Conventionally manufactured mineral wool pads which are cut according to the blocks' perforation geometry are used as a basis for filling the holes in the clay blocks. In a further stage, the panel sections (cuttings) thus produced are picked up with grippers by a robot and inserted into the perforations in the clay blocks via

a matrix. The mineral fibre pads used are already adjusted for filling the clay blocks with regard to bulk density and geometry. This allows waste due to cuttings to be completely avoided.

Mineral wool granulate filling:

With this kind of filling, mineral wool granulate is inserted into the blocks.

Polystyrene filling:

Loose polystyrene balls which are filled into the clay block chambers and solidly bonded with steam and pressure are used as a basis for filling the holes in the clay blocks. No waste is produced during filling.

Wood shavings filling:

The wooden fibre filling is shaken into the holes in the blocks.

2.8 Environment and health during use

Health protection during manufacture:

Trade association regulations apply; no special measures need to be taken to protect workers' health. Special regulations for vertically perforated blocks filled with mineral wool must be complied with: Mineral fibre insulation labelled with the *RAL quality mark* fulfils the criteria of Appendix IV No. 22 Paragraph 2 *Ordinance on Hazardous Substances*. Minimum protective measures to protect staff from dust must also be taken with glass and mineral wool fibres which carry the RAL quality label (see also Nos. 4 and 5 of *TRGS 500*). Application of the minimum protective measures especially protects against health impairments of the respiratory organs and skin-irritating effects of the fibres. The minimum protective measures comply with the *BG Bau* operating procedure: *Handling mineral wool insulation (glass wool and mineral wool)*

Environmental protection during manufacture:

Water/Soil:

No direct contamination for water or soil is produced. The process runs free of wastewater. The mixing water used is released again during the drying process as steam. The waste heat from the tunnel furnace is used to dry the block blanks (energy network).

Air:

The emissions from the firing process are below the threshold values of the *Technical Instructions on Air Quality Control (TA Luft)*. Environmental protection measures are oriented towards the lowest possible energy use and low-emission exhaust air. If necessary, a reduction in emissions can be achieved by afterburning the low temperature carbonisation gas, the operation of limescale packed bed filters and the selection of fuels which contribute to reducing CO₂ (e.g. natural gas). Computer-aided optimisation also improved the firing management.

Noise:

Due to noise protection measures, the measurement values (workstation and indoors) are far below the required values.

2.9 Product processing/installation

Processing recommendations:

The clay blocks are joined to one another and with other standardised building materials with mortar (ordinary, light, medium- or thin-bed mortar) or Dryfix plane block adhesive. When selecting the mortar, care should be taken that it does not negatively affect the block's health and environmental compatibility as described (see the manufacturer's recommendation available on request).

The processing of blocks filled with insulation is described product- and system-dependently in brochures and data sheets. Possible health effects during processing in line with *BG Bau's* operating procedure: *Handling mineral wool insulation (glass wool and mineral wool)* are to be pointed out.

Occupational safety/Environmental protection:

The weights of individual blocks are below the 25kg recommended by the building trade association. Occupational safety measures in accordance with trade association regulations and in compliance with manufacturer recommendations must be adhered to when laying the blocks. Wet procedures are normally prescribed for cutting and severing work. A dust mask (P3/FFP3) should be worn during dry cutting work.

Occupational safety measures in accordance with trade association regulations and in compliance with manufacturer recommendations must be adhered to when laying blocks filled with mineral wool. For example, no fast-running motorised saws without dust extraction may be used for cutting and severing work. The occupational safety measures in accordance with Section 3 of the *BG Bau* trade association's operating procedure: *Handling mineral wool insulation (glass wool and mineral wool)* must also be complied with.

Residual material:

The remains of blocks which accrue on the building site are to be collected separately. Correctly sorted block remains can be taken back by manufacturing plants and used as raw material or in other ways (for details see 2.15).

2.10 Packaging

The polyethylene foil is recyclable. Non-contaminated PE foil (which should be sorted correctly) and reusable wooden pallets are taken back via the building materials trade (reusable pallets against a refund in the deposit system) and thus returned to the factory; they pass on the PE foil to specialist disposal companies via a contractual agreement.

2.11 Condition of use

Ingredients:

As detailed in 2.6 Basic materials, clay blocks consist mainly of clay, sand and the fillers perlite, mineral wool, polystyrene and wood shavings. Block ingredients are bound as solid substances during their service life (ceramic binding).

Filled clay blocks have better insulation properties than unfilled clay blocks.

Durability during service life:

Clay blocks do not change once they leave the tunnel furnace. They are unlimitedly durable if used as intended.

Clay blocks are resistant against vermin, rotting, vegetation, acid and alkalis.

2.12 Environment and health during use

Clay blocks filled with insulation emit no substances which are hazardous to health or the environment. The naturally ionising radiation of clay blocks is extremely low and not a hazard for health.

The concentration of mineral wool fibres indoors is:

- generally not increased in the use phase if the blocks have been manufactured correctly.
- generally only moderately increased if the mineral wool products have been inserted in such a manner that they can directly exchange air with indoors

2.13 Reference period of use

The reference period of use if installed in accordance with the current rules of technology is 150 years (European brick industrial association PCR document): *TBE PCR document*).

Buildings which are built with clay blocks can be operated for just as long.

2.14 Extraordinary influences

Fire

Clay blocks filled with insulation are tested and approved by the buildings inspectorate with regard to their fire resistance period and fire-resisting wall properties. REI 30 to REI-M 120 (*DIN EN 13501- 2*) are achieved. The specific data is available in the respective approval.

Fire protection

| Name | Value |
|------------------------------------|--------------------------------------|
| Building materials class - blocks | A1 |
| Building materials class - filling | To be found in the relevant approval |

Water

No ingredients hazardous to water can be washed out under the influence of water (e.g. flooding) due to the fixed ceramic bond.

Mechanical destruction

No risks for the environment and living organisms is known of in case of unforeseen mechanical destruction.

2.15 End-of-life phase reuse and further use

Clay blocks filled with insulation have only been produced since 2001 and have so far not been reused or used further due to their durability. Blocks filled with perlite can be used in the manufacturing process in ground form as a filler. Filler materials and blocks can be separated by grinding with subsequent visual inspection. Correctly sorted mineral wool can be reintroduced into the manufacturing process. Polystyrene can be turned into electricity in waste to energy systems, added to block clay as a porosity agent or reused proportionately in the manufacture of

insulation board. Correctly sorted clay blocks from demolition can be taken back by block manufacturers and reused in manufacturing ground up as filler. This has already been practiced for decades.

Opportunities for further use exist as an additive for block chippings concrete, as a filling or bulk material in road construction and underground engineering, material for refilling pits and quarries, the construction of noise protection embankments and also as meal and sand for tennis courts.

2.16 Disposal

Block remains which collect on the building site and also blocks from demolition can be disposed of without problems as long as the aforementioned recycling options are not practicable and represent no extraordinary impact for the environment. Due to the chemically neutral, inert and immobile behaviour of clay blocks they can be stored on Class I waste sites in accordance with landfill class I in accordance with the Landfill Ordinance or used in pits and quarries as in Z1.1. The waste catalogue number is EWC 17 01 02 Bricks *Waste Catalogue Ordinance*. Clay blocks filled with insulation are to be disposed according to waste catalogue number 170904, mixed construction and demolition waste.

2.17 Further information

Further information is available at www.ziegel.de

3. LCA: Calculation rules

3.1 Declared unit

The declaration refers to one cubic metre of clay block with a bulk density of 605 kg/m³. The basis of the LCA results in this EPD is the formation of an average for all German plants which was done as a weighted average in relation to the share of the individual production plants in the total annual production.

Declared unit

| Name | Value | Unit |
|---------------------------|--------|-------------------|
| Declared unit | 1 | m ³ |
| Bulk density | 605 | kg/m ³ |
| Conversion factor to 1 kg | 605 | - |
| Conversion factor to 1 t | 1.6529 | |

3.2 System boundary

EPD type: Cradle to factory gate with options. The LCA includes obtaining raw materials, raw material transport and actual product manufacturing including the packaging materials (Modules A1–A3). Transport to the building site (Module A4) and the treatment of the packaging materials in waste incineration plants after installation of the product (Module A5) are also part of the system boundary. The product is dismantled after the end of the period of use (Module C1).

Disposal in inert matter landfill (Module C4) is provided for around 6% of the blocks after transport of the dismantled product (Module C2); 94% can be used further. Credits as a result of recycling clay blocks are declared in Module D. Credits for electricity and thermal energy as a result of the thermal recycling of the packaging within Module A5 are also included in

3.3 Estimations and assumptions

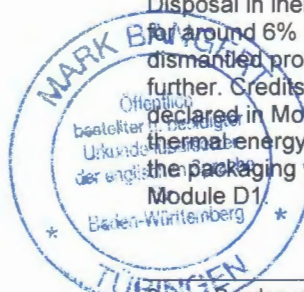
The *GaBi 9* database does not contain data for all raw materials or pre-products. The processes for some materials were estimated from pre-products which are similar in terms of production and environmental impact. The basic material of clay is for example substituted with the clay dataset. CO₂ emissions from sawdust and biogenic additives are mapped on the input side with a dataset and the previously stored CO₂ is completely released on the output side.

3.4 Cut-off rules

All data from company data collection is included, i.e. all initial materials used according to the formulations and the thermal and electrical energy used. Material and energy flows with a share of less than 1% were therefore also included. All data stated was integrated into the LCA model. Transport costs were calculated in for all basic materials, the shipping of products (A4) and in the end-of-life scenario (C2). The wear factor for wooden pallets and also machines, equipment and infrastructure required for manufacture were ignored. It can be assumed that the ignored processes would have contributed less than 5% each to the impact categories included.

3.5 Background data

thinkstep's *GaBi 9* software system for integrated lifecycle assessment was used to model the clay blocks. The consistent data in the *GaBi* database is documented online in the *GaBi* documentation. The base data in the *GaBi* database was used for energy, transport and auxiliary materials. In addition, the following was used for the filler material: Wood fibre:



STEICO SE's STEICOzell wood fibre blow-in insulation material EPD Declaration number: EPD-STE-20200172-IBA1-DE. The LCA was compiled for the supply area of Germany. This means that those pre-stages relevant for Germany such as electricity or energy carrier provision are used in addition to the production processes. The electricity mix and electricity from hydro-electric power, thermal energy from natural gas, heating oil and biomass for Germany for the reference year 2016 is used. Emissions from the firing process are collected as primary data based on measurements by Bundesverband der Deutschen Ziegelindustrie member companies.

3.6 Data quality

Data for the production year of 2019 is used to model the production stage of the clay blocks. All other relevant background data was taken from the database behind the *Gabi 9* software. The database was last updated in 2020. Data for the products examined is collected directly in the plants by Bundesverband der Deutschen Ziegelindustrie e.V. member companies. The majority of the data for the upstream supply chains originates from industrial sources which was collected under consistent temporal and methodical boundary conditions. Great importance is given to the completeness of the recording of environmentally relevant material and energy flows. The data quality can therefore be described as good.

3.7 Period under review

The period under review is 2019. The data represents an annual average across 12 months.

3.8 Allocation

A variety of materials are such as sawdust are used as additives. The sawdust is a by-product of the sawing process. An economic allocation is applied here in the corresponding background data to separate the impacts of the sawdust from that of sawn timber. The carbon dioxide content for sawdust and biogenic additives is included via the corresponding absorption of CO₂. These materials burn during the manufacturing process. The CO₂ emissions which occur are calculated in accordance with the theoretically complete transformation of carbon into carbon dioxide.

A variety of secondary materials such as sludge from paper recycling, paper fibre waste, secondary polystyrene and filter cake are used in the manufacture of the clay blocks. In the model, these materials are introduced into the system free of impacts.

The production process produces no ancillary products. There is therefore no allocation integrated into the applied LCA model. Broken blocks from production can be reused in production but can equally be used in various areas (road construction, tennis sand, etc.). The internally used broken clay blocks remain within A1-A3 (closed loop).

3.9 Comparability

Generally, a comparison or evaluation of EPD data is only possible if all data to be compared was created in accordance with *EN 15804* and the building context and product-specific features are taken into account.

The background data comes from service pack 39 of the 2019 *Gabi 9* database.

4. LCA: Scenarios and further technical information

Characteristic product properties of biogenic carbon

The total mass of biogenic carbon materials and the associated packaging make up less than 5 % of the product's total mass. The mass of packaging which contains biogenic carbon is 0.00031 kg.

Transport to the building site (A4)

| Name | Value | Unit |
|---|----------|-------------------|
| Litres of fuel | 1.19 | l/100 km |
| Transport distance | 107 | km |
| Capacity utilisation (including empty runs) | 85 | % |
| Bulk density of the products transported | 500– 900 | kg/m ³ |

Installation into the building (A5)

| Name | Value | Unit |
|--|-----------------------|------|
| Output materials as a result of waste treatment on the building site | 0.6 | kg |
| Material loss | See information below | |

The LCA results do not include environmental impacts through installation losses as these depend on the building project and therefore vary. The LCA results can be calculated for a specific installation loss (e.g. installation loss 3%, multiplication of the LCA results by 1.03) to calculate additional environmental impacts

which occur through manufacture and disposal. Should the user have no specific figure available for installation losses, a quota of 3% can be used for calculation (*TBE PCR document*).

Reference period of use

| Name | Value | Unit |
|---|-------|------|
| Service life (minimum according to BBSR) | 50 | a |
| Service life according to manufacturer specifications | 150 | a |

The reference period of use if installed in accordance with the current rules of technology is 150 years.

End-of-life (C1-C4)

| Name | Value | Unit |
|-------------------------|--------|------|
| As mixed building waste | 605 | kg |
| To recycling | 567.49 | kg |
| To landfill | 37.51 | kg |

The basic material clay contains limescale and dolomite which are broken down during the firing process and CO₂ is released (which is included in A1 to A3). A large proportion of the calcium and magnesium oxides is siliceously bonded. However, a smaller proportion exists as free alkaline or earth alkaline oxides in firing shards. These free oxides recarbonise with the aid of atmospheric CO₂. This process begins after leaving the furnace. Full recarbonisation of the free alkaline and earth alkaline oxides takes place during processing in the dismantling phase at the latest; these provide on

average 2 mass % CO₂ per kg fired blocks as a credit
in Module C3 (*recarbonisation*)

**Reuse, recovery or recycling potential (D), relevant
scenario information**

See information in Chapter 3.

Scenario D: Credits due to recycling processed
building rubble

Scenario D1: Credits due to recycling the packaging
materials (from Module A5) are shown in Module D1.



5. LCA: Results

The following tables show the results of the indicators of the impact assessment, resource use and also waste and other output flows relating to one cubic metre of clay blocks. To convert the results to apply to one tonne of clay blocks, the results can be divided by the specific density (605 kg/m³) of the clay block and multiplied by 1,000. The LCA results do not include environmental impacts through installation losses as these depend on the building project and therefore vary. The LCA results can be calculated for a specific installation loss (e.g. Installation loss 3%, multiplication of the LCA results by 1.03) to calculate additional environmental impacts which occur through manufacture and disposal.

Important:

EP fresh water: This indicator was implemented in co-ordination with the characterisation module (EUTREND model, Strujis et al., 2009b, as implemented in ReCiPe; <http://epclca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>) calculated as "kg P eq".

| DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT) | | | | | | | | | | | | | | | | | |
|--|--|---------------|-------------------------------------|-----------|-----------------|-------------|----------|-------------|---------------|------------------------|-----------------------|---------------------------|-------------------|------------------|----------|--|--|
| Production stage | | | Construction process stage | | Use stage | | | | | | | | End of life stage | | | | Credits and loads beyond the system boundary |
| Raw material supply | Transport | Manufacturing | Transport from the gate to the site | Assembly | Use/application | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction/demolition | Transport | Waste processing | Disposal | Reuse, recovery or recycling potential | |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D | |
| X | X | X | X | X | ND | ND | MNR | MNR | MNR | ND | ND | X | X | X | X | X | |
| RESULTS OF THE LCA – ENVIRONMENTAL IMPACT in accordance with EN 15804+A2: 1 m ³ clay blocks (605 kg/m ³) | | | | | | | | | | | | | | | | | |
| Core Indicator | Unit | A1-A3 | A4 | A5 | C1 | C2 | C3 | C4 | D | D/1 | | | | | | | |
| Total GWP | [kg CO ₂ eq.] | 1.46E+2 | 4.15E+0 | 8.24E-1 | 3.52E-1 | 9.42E-1 | -1.01E+1 | 5.00E-1 | -1.46E+0 | -1.06E+0 | | | | | | | |
| GWP fossil | [kg CO ₂ eq.] | 1.46E+2 | 4.13E+0 | 8.30E-1 | 3.66E-1 | 9.38E-1 | 1.44E+0 | 5.41E-1 | -1.45E+0 | -1.05E+0 | | | | | | | |
| GWP biogenic | [kg CO ₂ eq.] | 2.91E-1 | 1.66E-3 | -3.90E-3 | -1.56E-2 | 3.77E-4 | -1.15E+1 | -4.29E-2 | -9.09E-3 | -4.39E-3 | | | | | | | |
| GWP luluc | [kg CO ₂ eq.] | 7.95E-2 | 1.73E-2 | -1.32E-3 | 1.47E-3 | 3.92E-3 | 5.29E-3 | 1.56E-3 | -4.84E-3 | -1.35E-3 | | | | | | | |
| ODP | [kg CFC11 eq.] | 2.91E-11 | 1.01E-15 | -1.59E-14 | 8.61E-17 | 2.30E-16 | 6.11E-15 | 2.03E-15 | -2.07E-14 | -1.61E-14 | | | | | | | |
| AP | [mol H ⁺ eq.] | 2.79E-1 | 3.83E-3 | -8.66E-4 | 1.73E-3 | 8.71E-4 | 1.35E-2 | 3.88E-3 | -4.61E-3 | -1.16E-3 | | | | | | | |
| EP fresh water | [kg PO ₄ eq.] | 1.40E-4 | 8.99E-6 | -2.17E-6 | 7.64E-7 | 2.04E-6 | 3.43E-6 | 9.32E-7 | -4.41E-6 | -2.20E-6 | | | | | | | |
| EP marine | [kg N eq.] | 4.73E-2 | 1.19E-3 | -3.29E-4 | 8.16E-4 | 2.71E-4 | 6.64E-3 | 9.99E-4 | -1.75E-3 | -3.75E-4 | | | | | | | |
| EP terrestrial | [mol N eq.] | 1.00E+0 | 1.45E-2 | -2.65E-3 | 9.04E-3 | 3.29E-3 | 7.30E-2 | 1.10E-2 | -1.92E-2 | -4.00E-3 | | | | | | | |
| POCP | [kg NMVOC eq.] | 1.35E-1 | 3.15E-3 | -8.81E-4 | 2.28E-3 | 7.17E-4 | 1.93E-2 | 3.02E-3 | -4.14E-3 | -1.01E-3 | | | | | | | |
| ADPE | [kg Sb eq.] | 1.62E-5 | 3.43E-7 | -2.25E-7 | 2.92E-8 | 7.79E-8 | 1.58E-6 | 4.88E-8 | -3.14E-7 | -2.28E-7 | | | | | | | |
| ADPF | [MJ] | 1.58E+3 | 5.48E+1 | -1.49E+1 | 4.66E+0 | 1.25E+1 | 2.71E+1 | 6.90E+0 | -1.91E+1 | -1.51E+1 | | | | | | | |
| WDP | [m ³ world eq. extracted] | 4.89E+0 | 1.78E-2 | 1.61E-1 | 1.51E-3 | 4.04E-3 | 2.42E-1 | 5.65E-2 | -3.55E-2 | -1.20E-2 | | | | | | | |
| Key | GWP = Global warming potential; ODP = Depletion potential for the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential for tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources (ADP – materials); ADPF = Abiotic depletion potential for fossil resources (ADP = fossil energy carriers); WDP = water extraction potential (user) | | | | | | | | | | | | | | | | |
| RESULTS OF THE LCA – INDICATORS TO DESCRIBE THE USE OF RESOURCES in accordance with EN 15804+A2: 1 m ³ clay blocks (605 kg/m ³) | | | | | | | | | | | | | | | | | |
| Indicator | Unit | A1-A3 | A4 | A5 | C1 | C2 | C3 | C4 | D | D/1 | | | | | | | |
| PERE | [MJ] | 2.43E+2 | 3.10E+0 | 5.59E-2 | 2.71E-1 | 7.25E-1 | 2.28E+0 | 1.70E+0 | -5.45E+0 | -3.78E+0 | | | | | | | |
| PERM | [MJ] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | | | | | | | |
| PERT | [MJ] | 2.43E+2 | 3.10E+0 | 5.59E-2 | 2.71E-1 | 7.25E-1 | 2.28E+0 | 1.70E+0 | -5.45E+0 | -3.78E+0 | | | | | | | |
| PENRE | [MJ] | 1.59E+3 | 5.33E+1 | 5.59E-2 | 4.66E+0 | 1.25E+1 | 2.71E+1 | 1.29E+1 | -1.91E+1 | -1.51E+1 | | | | | | | |
| PENRM | [MJ] | 1.23E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | | | | | | | |
| PENRT | [MJ] | 1.59E+3 | 5.33E+1 | 5.59E-2 | 4.66E+0 | 1.25E+1 | 2.71E+1 | 1.29E+1 | -1.91E+1 | -1.51E+1 | | | | | | | |
| SM | [kg] | 1.42E+2 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 5.67E+2 | 0.00E+0 | 0.00E+0 | 0.00E+0 | | | | | | | |
| RSF | [MJ] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | | | | | | | |
| NRSF | [MJ] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | | | | | | | |
| FW | [m ³] | 2.05E-1 | 2.78E-3 | 4.05E-3 | 2.43E-4 | 6.50E-4 | 7.09E-3 | 3.26E-3 | 3.54E-3 | -2.06E-3 | | | | | | | |
| Key | PERE = Renewable primary energy as energy carrier; PERM = Renewable primary energy as material utilisation; PERT = Total use of renewable primary energy resources; PENRE = Non-renewable primary energy as energy carrier; PENRM = Non-renewable primary energy as material utilisation; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary materials; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water | | | | | | | | | | | | | | | | |

RESULTS OF THE LCA: WASTE CATEGORIES AND OUTPUT FLOWS in accordance with EN 15804+A2: 1 m³ clay blocks (605 kg/m³)

| Indicator | Unit | A1-A3 | A4 | A5 | C1 | C2 | C3 | C4 | D | D/1 |
|-----------|------|---------|---------|----------|---------|---------|---------|---------|----------|----------|
| HWD | [kg] | 1.68E-3 | 2.05E-6 | 2.28E-10 | 1.74E-7 | 4.66E-7 | 5.70E-7 | 1.08E-7 | -3.60E-7 | -7.95E-9 |
| NHWD | [kg] | 7.84E+0 | 9.62E-3 | 7.61E-3 | 8.18E-4 | 2.19E-3 | 3.15E-8 | 3.57E+1 | -1.12E+1 | -7.12E-3 |
| RWD | [kg] | 2.88E-2 | 5.77E-5 | 8.10E-6 | 4.91E-6 | 1.31E-5 | 2.17E-4 | 7.96E-5 | -7.12E-4 | -5.48E-4 |
| CRU | [kg] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| MFR | [kg] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 5.67E+2 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| MER | [kg] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| EEE | [MJ] | 0.00E+0 | 0.00E+0 | 3.42E+0 | 0.00E+0 | 5.00E-2 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| EET | [MJ] | 0.00E+0 | 0.00E+0 | 7.88E+0 | 0.00E+0 | 1.10E-1 | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |

Key HWD = Hazardous waste disposal; NHWD = Non-hazardous waste disposal; RWD = Radioactive waste disposal; CRU = Components for reuse; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories in accordance with EN 15804+A2-optional: 1 m³ clay blocks (605 kg/m³)

| Indicator | Unit | A1-A3 | A4 | A5 | C1 | C2 | C3 | C4 | D | D/1 |
|-----------|--------------------|-------|----|----|----|----|----|----|----|-----|
| PM | [Cases of illness] | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| IR | [kBq U235 eq.] | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ETP- fw | [CTUe] | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HTP- c | [CTUh] | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HTP- nc | [CTUh] | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SQP | [-] | ND | ND | ND | ND | ND | ND | ND | ND | ND |

Key PM = Potential Occurrence of Diseases due to Particle Emissions; IR = Potential Effects through Human Exposure to U235; ETP- fw = Potential Toxicity Comparison Unit for Ecosystems; HTP- c = Potential Toxicity Comparison Unit for Humans (carcinogenic effect); HTP- nc = Potential Toxicity Comparison Unit for Humans (non-carcinogenic effect); SQP = Potential Soil Quality Index

*GWP in Module C3 contains -20 kg CO₂ eq./t through carbonation.

The impact assessment results show relative statements/potentials which give no information on concrete environmental impacts (endpoint); no exceeded limits or risk analyses can be derived from this.

Below are the restriction notices for the declaration of core and additional environmental impact indicators:

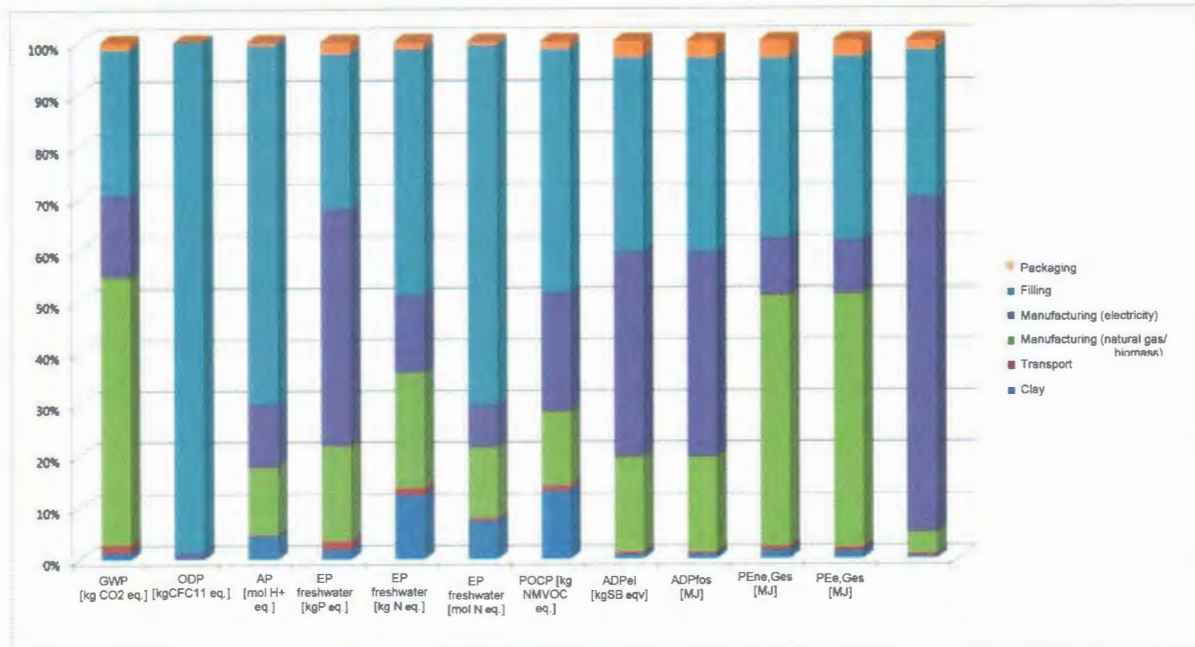
Restriction notice 2:

ILCD classification = ILCD Type 3, Indicator: ADP minerals and metals, ADP fossil, WDP Water Deprivation Potential

Restriction notice 2 – The results of this environmental impact category must be applied with care as uncertainties with these results are high or because there is a lack of experience with the indicator.



6. LCA: Interpretation



The analysis of the lifecycle assessment indicators for filled clay blocks shows that the environmental impacts are specifically dominated in all environmental categories by energy consumption during the manufacturing process (electricity and thermal energy) in the plant and the associated emissions due to the firing process and the filling materials. Process-related emissions are to a large extent related to raw materials. The quality of the clays used therefore also play a not insignificant role. With filled clay blocks, the filling takes on a significant role. The environmental impacts are caused by the upstream supply chains for manufacturing the filling materials on the one hand and the energy required for the filling process (electricity and thermal energy) on the other. Packaging and transport take on only a very subordinate role.

Deviation of the impact assessment results from declared average values is low.

Compared to the original EPD from 2015, this EPD update shows lower environmental impacts in all environmental categories. The reasons for this are the higher regenerative share of the German electricity mix compared to the electricity mix five years ago, optimisations in the manufacturing process and higher depth of detail in data collection.

The data quality for modelling Bundesverband der Deutschen Ziegelindustrie e.V. filled clay blocks can be regarded as good. Corresponding data was present in the GaBi database for all relevant basic and auxiliary materials used. The processes for some materials were estimated from pre-products which are similar in terms of production and environmental impact.

7. Requisite evidence

Research and assessments show that the natural radioactivity of clay blocks permit unlimited use of this building material from a radiological point of view. Clay blocks do not contribute to a relevant increase in radon

concentration in rooms; their contribution to the inhalation dose is negligible compared to the amount of radon in the ground. (Information leaflet: Natural radionuclides in building materials)

8. References

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DIN EN 771-1:2015-11, Specification for masonry units - Part 1: Clay masonry units

DIN EN 772-1
DIN EN 772-1:2016-05, Methods of test for masonry units - Part 1: Determination of compressive strength

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DIN EN 772-13:2000-09, Methods of test for masonry units - Part 13: Determination of net and gross dry density of masonry units (except for natural stone)

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DIN 4108-4

DIN 4108-4:2020-11, Thermal insulation and energy economy in buildings - Part 4: Hygrothermal design values

DIN EN 13501-2

DIN EN 13501-2:2016-12, Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services

DIN 20000-401

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EN 15804

EN 15804:2012+A2:2019, Sustainability of construction works- Environmental Product Declarations- Core rules for the product category of construction products.

EU Regulation no.305/2011

EU Regulation no 305/2011 Ordinance of the European Parliament and Council of 9th March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC.

CPR (EU): 2013-07 Regulation no. 305/2011
Building Products Directive

REACH

EU Regulation no. 1907/2006 EU chemicals ordinance which came into effect on 1st June 2007. REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals

Ordinance on Hazardous Substances

Ordinance on Hazardous Substances of 26th November 2010 (Federal Legal Gazette 1 p. 1643, 1644), last amended by Article 2 of the ordinance of 15th July 2013 (Federal Legal Gazette 1 p. 2514)

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BG Bau: Handling mineral wool insulation (glass wool and mineral wool) operating procedure, 03/2014. <http://bgbau-medien.de/html/pdf/bau341.pdf>

RAL quality mark Gütezeichen Mineralwolle

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STEICOzell Steico SE wood fibre blow-in insulation material EPD

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