ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Wienerberger AS**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-WIE-20130206-IAB1-EN
Issue date	03.03.2014
Valid to	02.03.2019

Bricks
Wienerberger AS

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com / https://epd-online.com

Wienerberger
Building Material Solutions

1. General Information

Wienerberger AS	Extruded brick
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 D-10178 Berlin	**Owner of the Declaration** Wienerberger AS Brobekkveien 40 0598 Oslo Norway
Declaration number EPD-WIE-20130206-IAB1-EN	**Declared product / Declared unit** 1 ton of extruded brick
This Declaration is based on the Product Category Rules: Bricks, 07-2013 (PCR tested and approved by the independent expert committee)	**Scope:** This document refers to the manufacturing of the average out of two product groups of extruded brick produced by Wienerberger AS at Bratsberg in Norway. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 03.03.2014	
Valid to 02.03.2019	**Verification** The CEN Norm EN 15804 serves as the core PCR Independent verification of the declaration and data according to ISO 14025 ☐ internally ☒ externally
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dr. Burkhart Lehmann (Chairman of SVA)	Mr Carl-Otto Neven (Independent tester appointed by SVA)

2. Product

2.1 Product description
Facing bricks belong to the group of baked clay building materials. This EPD concerns the average brick produced at Bratsberg brick plant. The average brick represents both solid and perforated bricks. These are all extruded bricks.
The clay used at the Bratsberg brick plant is red burning. To produce other colors, manganese oxide and lime can be added to the clay. This affects the technical properties of the brick, such as suction rate and compressive strength. The Bratsberg brick product range is therefore divided into two groups, low suction red bricks and high suction lime added bricks. For 2012 the split between these two groups was approximately 50/50.
Technical lifetime of bricks is 150 years.

2.2 Application
Facing bricks for external and internal loadbearing and non-loadbearing walls and building elements, in combination with masonry mortar.

2.3 Technical Data
Extruded bricks:

Constructional data

Name	Value	Unit
Compressive strength NS-EN 772-1	60	N/mm^2
Gross density NS-EN 772-13	1395	kg/m^3
Modulus of elasticity	10	N/mm^2
Thermal conductivity	6	W/(mK)
Moisture content at 23 °C, 80%	0.35	V.-%
Sound absorption coefficient (for sound protection walls and sound protection partition walls)	2 - 5	%

2.4 Placing on the market / Application rules
For the marketing in the EU/EFTA the Regulation (EU) No 305/2011 dated from 9 March 2011 applies. The products need a Declaration of Performance taking into consideration the harmonized Norwegian standard /NS-EN 771-1: 2011/ "Specification for masonry Part 1: Facing bricks" and the CE-marking.

For the application and use the respective national provisions apply.

2.5 Delivery status
Dimensions of delivered Wienerberger bricks (l x b x h):

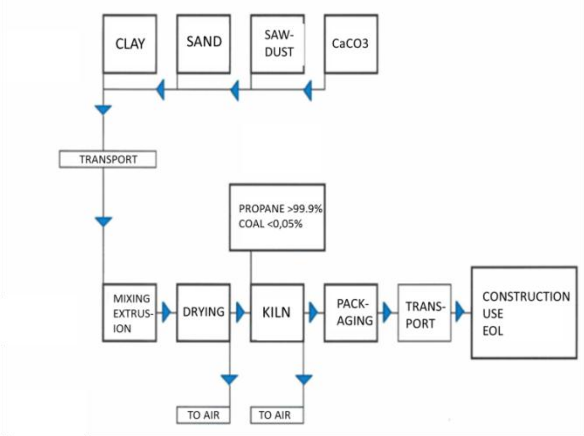
Normal format NF, perforated; 226 x 104 x 60 mm
Normal format NF, solid; 226 x 104 x 60 mm
Rehab format RF, perforated; 226 x 85 x 60 mm

2.6 Base materials / Ancillary materials

	Red clay	Lime added clay
Clay	89,3%	78%
Lime	0%	12%
Sawdust	2,4%	2,1%
Chamotte	2,2%	1,8%
Sand	5,4%	4,6%

When necessary Manganese oxide (< 1 %), and Carboxy-Methylcellulose (< 0,02 %), are used.

2.7 Manufacture



Bratsberg teglverk manufactures bricks according to NS-EN 771-1 and the Factory Production Control manual (FPC) is established to continuously document the conformity with the this standard and the declared values of the produced bricks.
The FPC consists of procedures for production control, as raw material and finished products testing and actions to be taken if deviation occurs.
The production is in the System 2+, and a subject of third party inspection, notified body is Dancert A/S.

2.8 Environment and health during manufacturing

Reports to Norwegian Environment Agency: Greenhouse gas emission reports

Emission measurements in discharged air of NOx, CO, SO2, TOC, dust, fluoric acid and hydrochloric acid. This is done to meet the demands from Norwegian Environment Agency 4 times/year to verify that emissions from the production do not exceed the given limits by the agency.

Automatic fire guard, yearly inspection of gas equipment
Internal safety inspections and safety guidelines according to National workplace regulations
Company health service

- Measures of dust content in indoor air (once a year)
- Blue collar workers health checks (lungs, hearing)
- Indoor noise level measurement

2.9 Product processing/Installation

Ceramic facing bricks are used in combination with regular mortar, correspondingto the suction rate of the brick, for construction of masonry walls. The masonry can be load bearing or non-load bearing.

Brick masonry should be executed in accordance with the /NS 3420-N:2012/ Specification text for building, construction and installation part N: masonry and rigid tile work.

The labels on the brick pallets are marked with safety signs, recommending use of protective equipment during installation, such as protective footwear, protective glasses, hearing protection, and gloves when handling bricks. Cutting bricks with electric tools can produce dust containing silicates and quarts particles that might cause health damages, dust mask FFP3 is recommended.

2.10 Packaging

PE Plastic film is used on each pallet. Paper sheets are used between layers of bricks on pallets with bricks. The small brick pallets are delivered on non-returnable wood pallets. All materials are recycled on building site. The end-of-life (EoL) of the packaging material is included in the life-cycle-assessment (LCA).

2.11 Condition of use

The composition of the brick is as stated in the chapter “Base materials”. There will be no alteration in the content of the brick or the properties of the brick during the technical life time of the product.
All fillers are burned during manufacturing, and the brick is inert during the use phase (no emissions occur).

2.12 Environment and health during use

Bratsberg bricks contain no harmful substances and emit no emissions to air, soil and water during use. Bratsberg bricks do not contain any substances from the restricted substances-list, BREEAM nor A20-list, which is the toxic environmental list of Norway.

Maintenance of bricks during use is normally limited to low pressure cleaning with pure water. The cleaning frequency is related to the local environmental impact, normally less frequent than every 10th year.

2.13 Reference service life

Technical life time is 150 years

2.14 Extraordinary effects

Fire

Fire protection according /NS-EN 13501/

Fire protection

Name	Value
Building material class	A1
Burning droplets	d0
Smoke gas development	s1

Water

No impact.

Mechanical destruction

Not relevant.

2.15 Re-use phase

Re-use of bricks occur at different stages; burned brick waste is re-used in brick production as crushed chamotte added to the clay.
Unbroken demolition bricks can be re-used in new masonry.

As bricks emit no harmful substances to air, soil or water, they can be used as aggregates in building material, aggregates to soil due to water retaining properties and aggregates in special soil for Green roofs.

2.16 Disposal

Wienerberger bricks comply with the European waste code 170102. If they cannot be re-used as stated in section 2.15, bricks can be disposed in landfills for inert material. They do not represent hazardous waste and there are no emissions to the environment to expect.

Wienerberger AS is a member of Grønt punkt / Green dot, recycling the plastic package of the pallets in production and on building site.

2.17 Further information

Bratsberg facing bricks are conforming to /NS-EN 771-1:2011/ Specification for masonry units – Part 1 clay masonry units. They fulfill the requirements of this standard for HD masonry units (density > 1000 kg/m3) Facing bricks have a CE - marking, a Declaration of conformity and a Declaration of performance.

For additional information: www.wienerberger.no.

3. LCA: Calculation rules

3.1 Declared Unit

The modelling is scaled to a reference unit of 1 ton of brick.
Data from the producing site Bratsberg were collected for the calculation. As there are two groups of bricks produced at the production site, the input masses were collected and divided through the overall production volume of the brick production site. The manufacturing of both groups of bricks represents a comparable process. In order to attain a diverse spectrum of products, Wienerberger bricks are sold in various thicknesses and differing void ratios. Based on consumer related specifications, lime and manganese oxide can be added to the product in order to get different colours of the brick. As there are several additives and porosive agents which can be added to the bricks depending on the specifications and various recipes of each product, this LCA is concentrating on an average extruded brick of Wienerberger AS. Due to this varying specifications of different kinds of bricks and the collection of data referring to units of mass. An average produced brick of 1 ton is calculated in the model and represents the functional unit.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Gross density	1395	kg/m^3
Conversion factor to 1 kg	0.001	-
Conversion factor 1t to m^3	7,17E-04	-

3.2 System boundary

Type of the EPD: cradle to gate.
1c) Declaration of an average product from a manufacturer's plant.
The life-cycle analysis of the products under investigation includes only the 'product stage'.
Thus, the systems include the following stages according to EN 15804:
Product stage (module A1-A3)
A1 raw material extraction and processing
A2 transport to the manufacturer
A3 manufacturing
The product stages A4-A5, B1-B7, C1-C4 and D were excluded from this study.

3.3 Estimates and assumptions

The model assumes one third of the waste brick fragments which stem from the manufacturing process to be used as roadfill in clay pits or aggregates for green roofs. Two thirds of the waste brick fragments are looped in production.

3.4 Cut-off criteria

In this study, available data from production contributing more than 1% of mass or energy are considered. The manufacturers provided data on the transport expenditure for all considered raw materials. Reusable Euro-pallets, contributing 0,02% were cut-off. In addition, the engobes used for bricks were cut-off as they contribute about 0,03% of mass to the overall production amounts. Due to the fact, that the engobes are mainly made out of clay minerals mixed with some additives, a negligible contribution to the environmental impacts associated with the life-cycle of the product can be expected. The incineration of packaging paper is cutoff, as there is already a proportion of recovery paper included in the paper input. It can be assumed that all cut-off processes do not exceed 5 % of the environmental impacts associated with the product. As a result, the cut off criteria according to DIN EN 15804 are fulfilled.

3.5 Background data

All relevant background datasets were taken from the GaBi 6 software data base being less than 10 years old. Used data were collected under consistent temporal and methodological conditions.

3.6 Data quality

Data acquisition for the products under investigation took place at the production site based on a questionnaire which was developed by PE International. In- and output data were collected based on the reference year of 2012 and were proved for plausibility. As a result, a high representativity of the used data can be assumed.

3.7 Period under review

Data were collected in the time frame of 01.01.2012 - 31.12.12.

3.8 Allocation

Residual production waste exclusively representing non-brick compounds are incinerated in a municipal incineration plant. Thus, accruing electricity credits are looped back in module A1-A3 as electricity input in the manufacturing process without the necessity of an allocation procedure.
Credits from energy substitution (production waste incineration) can be allocated to the production stage, because the gained energy from energy substitution is lower than the energy input in this stage. The same quality of energy is considered.
A closed loop is applied for the main part of the brick processing waste (67%) which is looped in the model

and serves as material for the chamottes needed as input for the brick production.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to EN 15804 and the building context, respectively the product-specific characteristics of performance, are taken into account.

4. LCA: Scenarios and additional technical information

The calculated scenario implies the use of brick fragments representing manufacturing waste of the production process as roadfill in clay pits or aggregates in soil for green roofs . There is no EoL scenario calculated.

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5. LCA: Results

The following tables show the results of the environmental impact assessment referring to the CML-impact categories, resource use, output flows and waste categories scaled to the functional unit of 1 ton of average extruded brick produced by Wienerberger AS in Norway.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 t of brick

Parameter	Unit	A1 - A3
Global warming potential	[kg CO_2-Eq.]	2.776E+2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	1.033E-7
Acidification potential of land and water	[kg SO_2-Eq.]	6.215E-1
Eutrophication potential	[kg $(PO_4)^{3-}$- Eq.]	8.021E-2
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	1.139E-1
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	6.675E-5
Abiotic depletion potential for fossil resources	[MJ]	3.393E+3

RESULTS OF THE LCA - RESOURCE USE: 1 t of brick

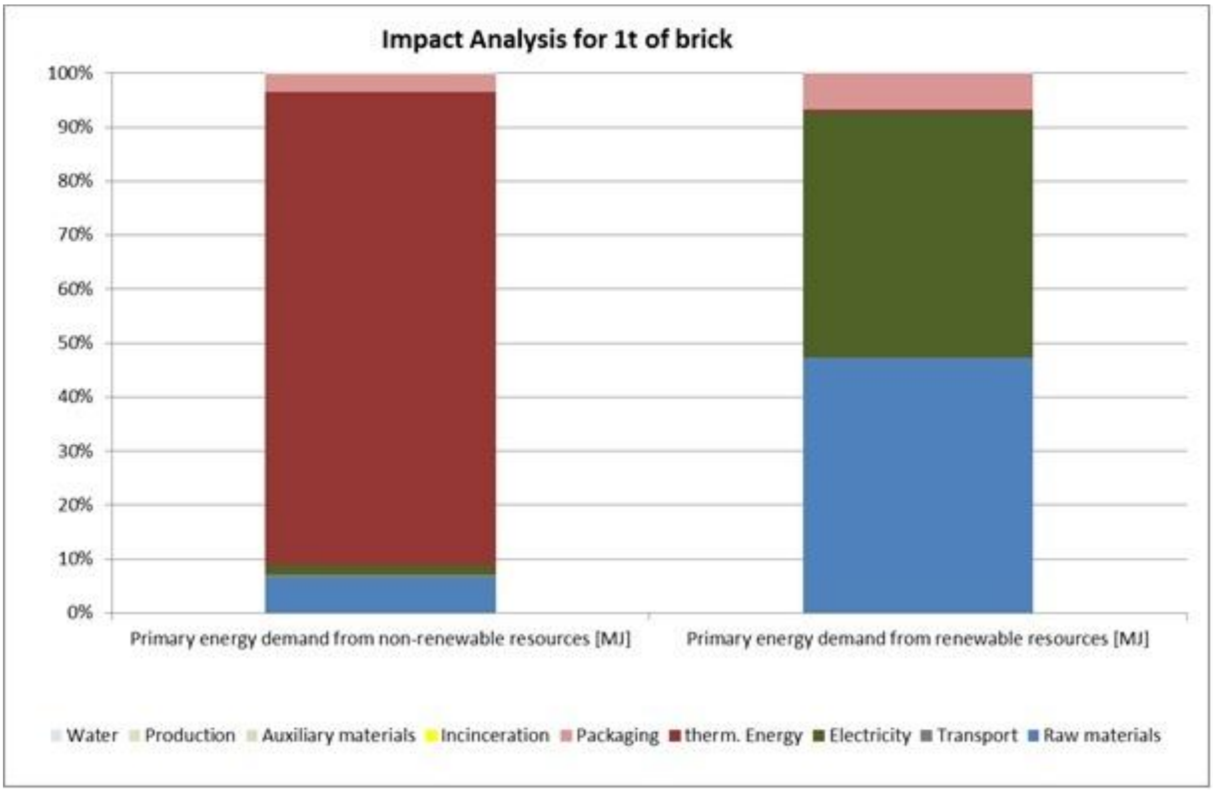
Parameter	Unit	A1 - A3
Renewable primary energy as energy carrier	[MJ]	1.155E+3
Renewable primary energy resources as material utilization	[MJ]	0
Total use of renewable primary energy resources	[MJ]	1.155E+3
Non renewable primary energy as energy carrier	[MJ]	3.431E+3
Non renewable primary energy as material utilization	[MJ]	0
Total use of non renewable primary energy resources	[MJ]	3.431E+3
Use of secondary material	[kg]	0
Use of renewable secondary fuels	[MJ]	7.128E-2
Use of non renewable secondary fuels	[MJ]	7.412E-1
Use of net fresh water	[m³]	1.093E+0

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 t of brick

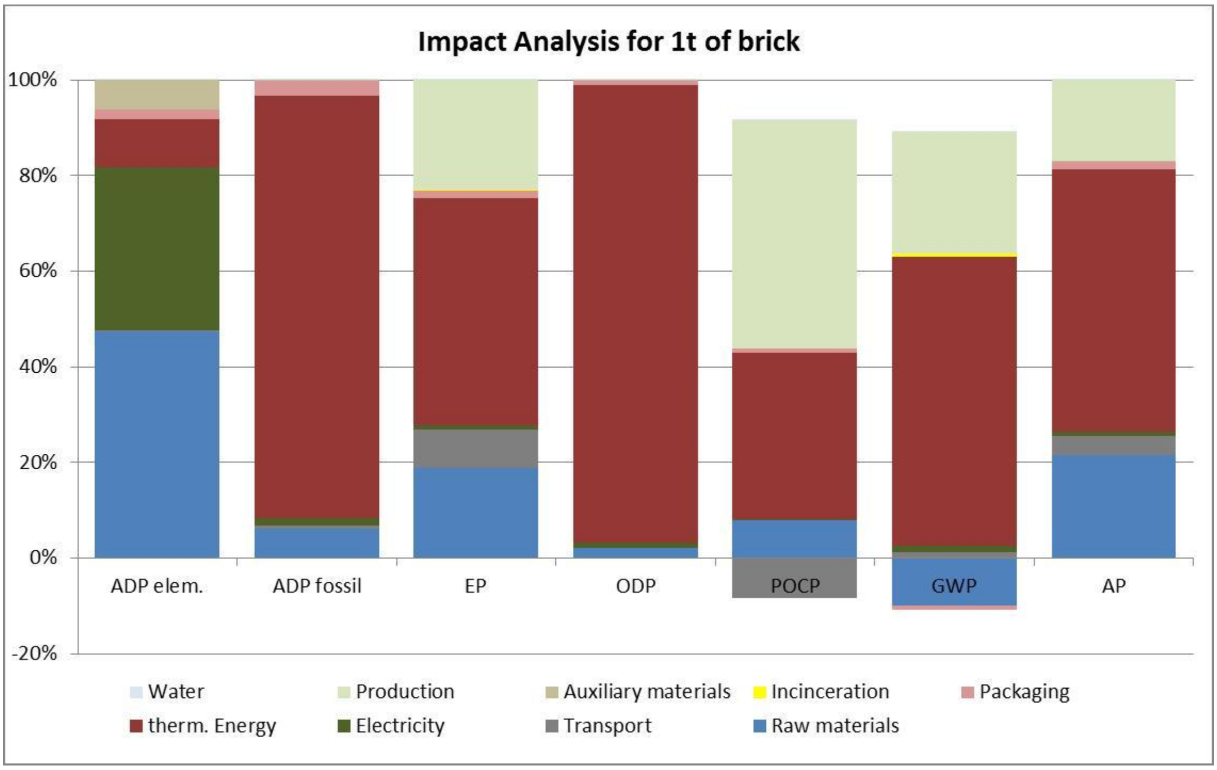
Parameter	Unit	A1 - A3
Hazardous waste disposed	[kg]	1.156E-1
Non hazardous waste disposed	[kg]	3.193E+0
Radioactive waste disposed	[kg]	1.585E-2
Components for re-use	[kg]	0
Materials for recycling	[kg]	0
Materials for energy recovery	[kg]	0
Exported electrical energy	[MJ]	0
Exported thermal energy	[MJ]	0

6. LCA: Interpretation

The results of this study show a clear dominance of thermal energy utilisation determining the scale of the environmental impacts associated with the product life-cycle of bricks.



The total use of renewable primary energy resources as well as the total use non-renewable primary energy is dominated by the usage of thermal energy (66%). As presented in the previous figure, the renewable energy demand is mainly generated by the raw material stage (47%) and electricity generation (45,5%). This high contribution of the raw material stage to overall renewable energy demand can be mainly traced back to the usage of roundwood in the production process, producing 48% of the PERE.



Global warming potential

The overall value of the global warming potential of 1 ton of brick arrives at 278 kg CO2-equivalents. This is mainly produced by the high amount of thermal energy used for the production of bricks making up 60% of the total GWP. Additionally, the production phase of bricks includes CO2-emissions, contributing 25% to the overall global warming potential. The raw material stage shows a negative value, due to the usage of wood products (timber, wooden pallets, paper) in which CO2 was stored during tree growth.
As a result, the saw dust comes in as raw material input which represents harvested biomass with a negative value for GWP due to the intake of CO2. Owing to the combustion of the saw dust during production, this negative value is converted into CO2 emissions in the production stage.

Ozone depletion potential

96% of the ozone depletion potential are generated due to the demand for thermal energy during the life-cycle of bricks. Trichlorethan, dichlortetrafluorethan and chlordifluormethan represent the main contributors to the ODP generated by thermal energy utilisation. The other product stages show only minor contributions to the ODP.

Acidification potential

55% of the acidification potential is produced by thermal energy utilisation. Secondly, the raw material (21%) and production stage (17%) contribute to the acidification potential. 64°% of the AP produced by raw materials are generated by the usage of manganese oxide.

Eutrophication potential

Thermal energy utilisation accounts for 48% of the eutrophication potential. Beyond that, raw materials and the production process itself contributes to the eutrophication analogously to the acidification potential.

Photochemical ozone creation potential

The photochemical ozone creation potential is mainly driven by the manufacturing phase of bricks (~48%), due to its generation of CO, SO2 and NOx.
Furthermore, thermal energy utilisation adds 35% to the photochemical ozone creation potential of bricks. There is a negative value for the POCP of the transports due to the fact that the transports emit more NO than NO2. As NO may react with O3 it leads to a decrease of the photochemical ozone creation potential.

Potential for abiotic depletion of resources - elements for non-fossil resources

The potential for abiotic depletion of elements is mainly determined by raw material utilisation (46,5%). Especially the usage of manganese oxide produces a high ADP elementary where the potential for abiotic depletion of manganese contributes 40% to the total ADP elementary of the raw material input. In addition, electricity generation accounts for 35% of the ADP.

Potential for abiotic depletion of resources - fossil fuels

The potential for abiotic depletion of fossil fuels is again dominated by thermal energy usage with 89% of the overall result. This high contribution can be clearly traced back to the utilization of crude oil to produce thermal energy (91%). The residual amount of thermal energy is mainly produced by the incineration of natural gas and represents a minor contributor (8,8°%).

Water consumption

The life-cycle of bricks includes the consumption of 1,1m³ water per ton of brick. This water consumption is mainly generated by the utilisation of the Norwegian electricity mix (76%) and the input of Carboxy-Methylcellulose contributing 15%.

Waste

The largest amount of waste produced during the life-cycle of bricks represents non-hazardous waste with a proportion of 96%. 76% of the total amount of non-hazardous waste is sand. Hazardous waste arrives at a share of 3,5% and radioactive waste contributes a small portion of 0,5%.

7. Requisite evidence

7.1 Radioactivity measurement

Monitoring executive: Institute for Energy Technology
Test report: 2013-1425 Analysis of natural radioactivity in one sample of chamotte
Methodology: Indirect determination of Rn and U using ^{214}Pb/^{214}Bi for Rn and ^{228}Ac for the ^{238}U- and the ^{232}Th series
Standard: Norwegian Standard NS-EN 12620
Results:

Series	^{238}U	^{232}Th	
Ra-isotope of concern	^{226}Ra	^{228,224}Ra	
Measured radionuclide	^{214}Pb, ^{214}Bi	^{228}Ac	^{40}K
Chamotte	63 ± 8	66 ± 6	610 ± 40

The Norwegian Radiation Protection Authority has previously published a limit of 300 Bq/kg for ^{232}Ra in masses brought into the construction site and a limit of 100Bq/kg for ^{226}Ra in building materials. None of these limits has been exceeded for the sample. The condition for the occurrence of natural radioactivity in building materials for indoor use (X = 0,75 +/-0,04) is also met for the sample.

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8. References

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CEN/TR 15941
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CPR 2011
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NS-EN 771-1
Harmonized Norwegian standard: 2011 Specification for masonry Part 1: Facing bricks

NS 3420-N:2012
Specification texts for building, construction and installations - Part N: Masonry and rigid tile work

NS-EN 13501
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HBEFA
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