Environmental Product Declaration

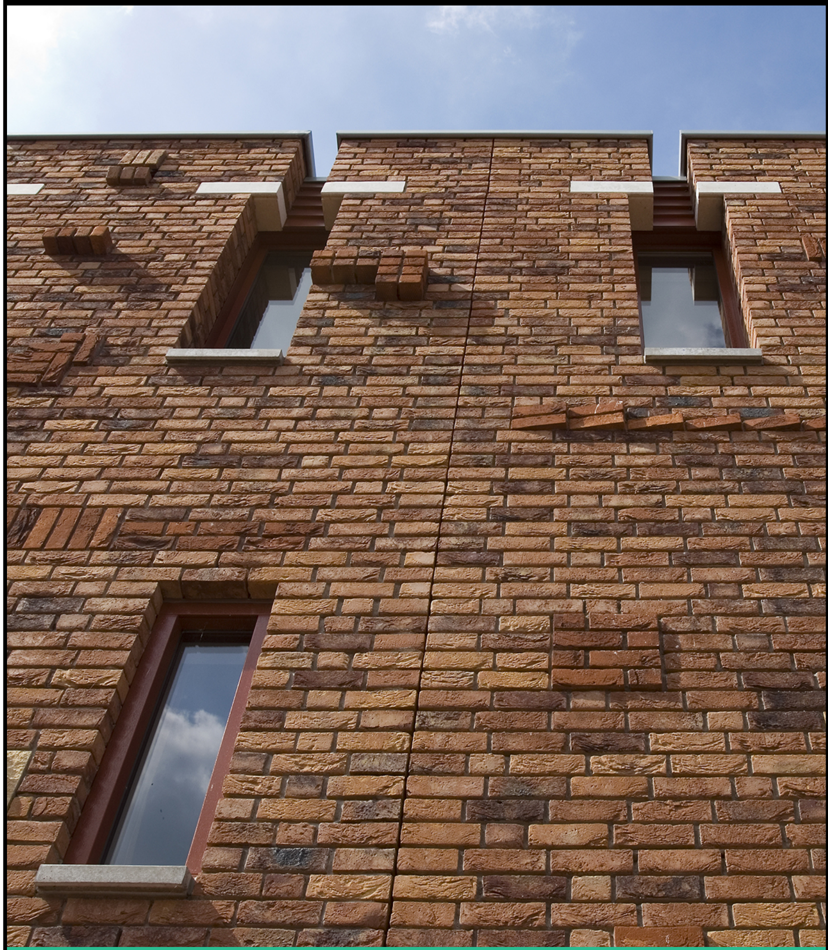
according to ISO 14025 and EN 15804

This declaration is for:

Facing bricks (clay masonry units) representative for the Dutch ceramics industry (KNB members)

Provided by:

KNB the Royal Dutch Construction Ceramics Association



program operator

Stichting MRPI®

publisher

Stichting MRPI®

www.mrpi.nl

MRPI® registration

1.1.00195.2021

date of first issue

12-04-2021

date of this issue

12-04-2021

expiry date

12-04-2026

COMPANY INFORMATION

KNB the Royal Dutch Construction Ceramics Associat
Florijnweg 6
6883 JP
Velp
0031 (0)26 384 5630
ing. A. Mooiman
www.knb-keramiek.nl

PRODUCT

Facing bricks (clay masonry units) representative for the Dutch ceramics industry (KNB members)

DECLARED UNIT/FUNCTIONAL UNIT

1 m² masonry work, including facing bricks for outdoor applications and mortar

DESCRIPTION OF PRODUCT

Facing bricks for outdoor applications in accordance with NEN-EN 771-1, applied in walls and foundations, decorative and load bearing.

VISUAL PRODUCT

MRPI® REGISTRATION

1.1.00195.2021

DATE OF ISSUE

12-04-2021

EXPIRY DATE

12-04-2026

MORE INFORMATION

www.knb-keramiek.nl

SCOPE OF DECLARATION

This MRPI®-EPD certificate is verified by **Kamiel Jansen, Primum.**
The LCA study has been done by **Bob Roijen, SGS Intron.**
The certificate is based on an LCA-dossier according to ISO14025 and EN15804+A1. It is verified according to the 'MRPI®-EPD verification protocol November 2020.v4.0'. EPDs of construction products may not be comparable if they do not comply with EN15804+A1. Declaration of SVHC that are listed on the 'Candidate List of Substances of Very High Concern for authorisation' when content exceeds the limits for registration with ECHA.

PROGRAM OPERATOR

Stichting MRPI®
Kingsfordweg 151
1043GR
Amsterdam

ir. J-P den Hollander, Managing director MRPI®

DEMONSTRATION OF VERIFICATION
CEN standard EN15804 serves as the core PCR[a]
Independent verification of the declaration and data, according to EN ISO 14025:2010: internal: external: X
Third party verifier: Kamiel Jansen, Primum
[a] PCR = Product Category Rules

DETAILED PRODUCT DESCRIPTION

The main raw material for facing bricks is clay. Clay is abundantly available in the Dutch floodplain. The clay stock is large and the supply by nature is a continuous process. Every year, more clay is deposited in the flood plains than is extracted. The mineral raw material is clay thus a renewable resource [Van der Meulen M.J, Deltares, Sediment management and the renewebility of floodplain clay for structural ceramics, 2009]. Clay extraction is subject to strict rules and is done with respect for flora and fauna. Extraction is done according to a ministerial approved Code of Conduct. After excavation of the clay, the clay extraction areas are returned to nature or given a new destination such as e.g. a recreational area.

The clay is often mixed with sand and water prior to the brick production. Depending on the type of facing brick, additives are added. To turn the clay mix into a ceramic product, a production process is in place that has been thoroughly optimized and automated. The production process consists of the following process steps:

- pre-treatment of the clay;
- shaping of the desired product;
- drying and firing process.

Thorough quality control is carried out at all stages of the production process. The technical lifetime is equal to the building lifetime. The reference service life (RSL) of facing bricks is 150 years. Facing bricks are sold partially packed.
In the context of the Dutch Soil Quality Decree (BBK), the facing bricks are provided with the NL-BBK certificate. The Soil Quality Decree sets the preconditions for the application of building materials on or in the soil or in surface water, to prevent unwanted dispersion of substances to the environment.

COMPONENT (> 1%)	[kg /per kg]
Clay	0.922
Sand	0.102
Additives	0.035
LDPE foil (packaging)	0.000048
Palets	0.00036

(*) > 1% of total mass

SCOPE AND TYPE

Facing bricks representative of the products made by members of KNB. The facing brick is manufactured in whole or in a part made from river clay extracted in the Netherlands and produced with natural gas and elektricity at production sites equipped with flue gas purifiers. The LCA study was carried out according to the rules formulated in the "SBK Assessment method for the environmental performance of Buildings and civil engineering works, version 3.0, January 2019 and the accompanying “SBK Verification Protocol recording environmental data in the national environmental database”, Version 3.0, January 2019.

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport gate to site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	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	x	x	x	x	x	x	x	ND	ND	x	x	x	x	x

X = Modules Assessed

ND = Not Declared

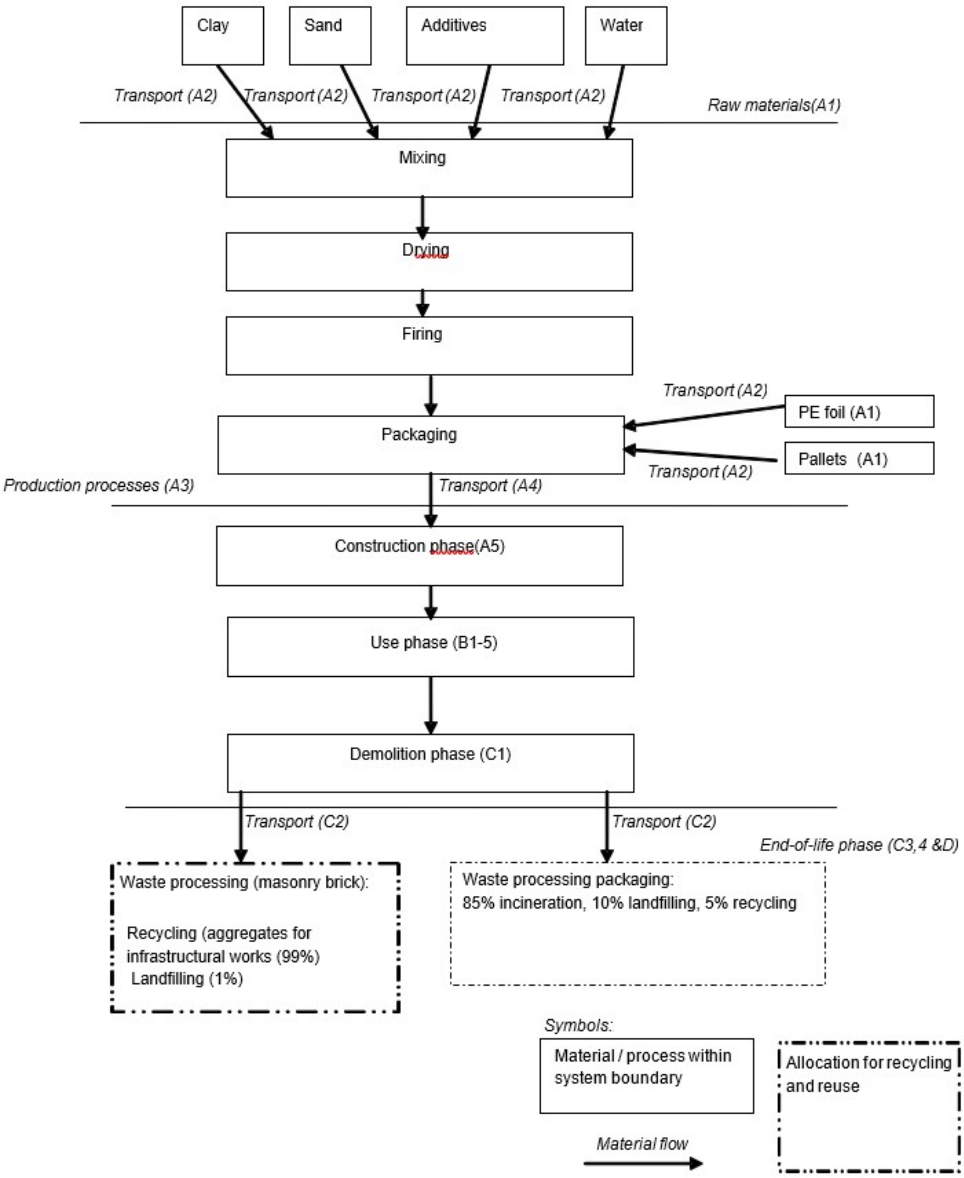


Figure: LCA process diagram according to EN 15804(7.2.1)

REPRESENTATIVENESS

All KNB members that produce facing bricks provided data. The geographical coverage reflects the physical reality for the declared product group. The data that together determine > 80% of the environmental impacts were collected in a similar manner, with similar accuracy.

ENVIRONMENTAL IMPACT per functional unit or declared unit (indicators A1)

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
ADPE	kg Sb eq.	5.71 E-6	5.36 E-7	1.88 E-6	8.13 E-6	1.09 E-5	6.48 E-6	0.00	0.00	0.00	0.00	0.00	2.61 E-6	3.43 E-6	1.74 E-7	1.09 E-8	-9.73 E-7
ADPF	MJ	1.20 E-2	1.66 E-3	1.36 E-1	1.49 E-1	2.82 E-2	1.57 E-2	0.00	0.00	0.00	0.00	0.00	1.44 E-2	8.90 E-3	2.16 E-3	1.30 E-4	-2.00 E-2
GWP	kg CO2 eq.	1.66 E+0	2.33 E-1	1.79 E+1	1.98 E+1	3.83 E+0	6.78 E+0	0.00	0.00	0.00	0.00	0.00	2.04 E+0	1.21 E+0	2.86 E-1	9.59 E-3	-2.90 E+0
ODP	kg CFC 11 eq.	2.43 E-7	4.09 E-8	1.46 E-6	1.74 E-6	7.05 E-7	1.83 E-7	0.00	0.00	0.00	0.00	0.00	3.70 E-7	2.22 E-7	3.33 E-8	3.17 E-9	-5.23 E-7
POCP	kg ethene eq.	1.30 E-3	1.37 E-4	4.26 E-3	5.70 E-3	2.26 E-3	1.97 E-3	0.00	0.00	0.00	0.00	0.00	1.73 E-3	7.12 E-4	1.60 E-4	1.02 E-5	-2.93 E-3
AP	kg SO2 eq.	1.08 E-2	1.17 E-3	2.44 E-2	3.63 E-2	1.66 E-2	2.23 E-2	0.00	0.00	0.00	0.00	0.00	1.29 E-2	5.23 E-3	1.32 E-3	7.09 E-5	-2.20 E-2
EP	kg (PO4)3- eq.	2.24 E-3	2.42 E-4	2.97 E-3	5.45 E-3	3.31 E-3	3.40 E-3	0.00	0.00	0.00	0.00	0.00	2.81 E-3	1.04 E-3	2.98 E-4	1.33 E-5	-4.92 E-3

Toxicity indicators and ECI (Dutch market)

HTP	kg DCB-Eq	5.36 E-1	8.33 E-2	3.76 E+0	4.38 E+0	1.53 E+0	7.47 E-1	4.39 E-1	0.00	0.00	0.00	0.00	7.57 E-1	4.82 E-1	6.26 E-2	3.91 E-3	-1.03 E+0
FAETP	kg DCB-Eq	7.79 E-3	2.40 E-3	1.35 E-2	2.37 E-2	4.49 E-2	1.37 E-2	9.44 E-1	0.00	0.00	0.00	0.00	1.53 E-2	1.41 E-2	1.05 E-3	9.72 E-5	-1.44 E-2
MAETP	kg DCB-Eq	2.95 E+1	8.50 E+0	5.35 E+2	5.73 E+2	1.62 E+2	1.40 E+2	9.38 E+2	0.00	0.00	0.00	0.00	5.38 E+1	5.11 E+1	4.01 E+0	3.34 E-1	-4.87 E+1
TETP	kg DCB-Eq	1.51 E-3	3.15 E-4	8.97 E-3	1.08 E-2	5.42 E-3	9.64 E-3	2.19 E-3	0.00	0.00	0.00	0.00	1.84 E-3	1.71 E-3	8.45 E-4	1.16 E-5	-1.72 E-3

ADPE = Abiotic Depletion Potential for non-fossil resources
ADPF = Abiotic Depletion Potential for fossil resources
GWP = Global Warming Potential
ODP = Depletion potential of the stratospheric ozone layer
POCP = Formation potential of tropospheric ozone photochemical oxidants
AP = Acidification Potential of land and water
EP = Eutrophication Potential
HTP = Human Toxicity Potential
FAETP = Fresh water aquatic ecotoxicity potential
MAETP = Marine aquatic ecotoxicity potential
TETP = Terrestrial ecotoxicity potential
ECI = Environmental Cost Indicator
ADPF = Abiotic Depletion Potential for fossil resources expressed in [kg Sb-eq.]
ND = Not Declared

RESOURCE USE per functional unit or declared unit (A1 / A2)

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
PERE	MJ	8.90 E-1	5.29 E-2	1.46 E+1	1.56 E+1	8.06 E-1	6.08 E+0	0.00	0.00	0.00	0.00	0.00	2.67 E-1	2.54 E-1	2.32 E-1	6.99 E-3	-2.41 E-1
PERM	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PERT	MJ	8.90 E-1	5.29 E-2	1.46 E+1	1.56 E+1	8.06 E-1	6.08 E+0	0.00	0.00	0.00	0.00	0.00	2.67 E-1	2.54 E-1	2.32 E-1	6.99 E-3	-2.41 E-1
PENRE	MJ	2.67 E+1	3.70 E+0	2.90 E+2	3.21 E+2	6.30 E+1	6.66 E+1	0.00	0.00	0.00	0.00	0.00	3.23 E+1	1.98 E+1	4.52 E+0	2.92 E-1	-4.49 E+1
PENRM	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PENRT	MJ	2.67 E+1	3.70 E+0	2.90 E+2	3.21 E+2	6.30 E+1	6.66 E+1	0.00	0.00	0.00	0.00	0.00	3.23 E+1	1.98 E+1	4.52 E+0	2.92 E-1	-4.49 E+1
SM	kg	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RSF	MJ	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NRSF	MJ}	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FW	m3	6.55 E-4	2.55 E-5	4.47 E-4	1.13 E-3	4.35 E-4	1.53 E+0	0.00	0.00	0.00	0.00	0.00	2.23 E-4	1.37 E-4	2.62 E-5	1.98 E-6	-3.11 E-4

PERE = Use of renewable energy excluding renewable primary energy resources
PERM = Use of renewable energy resources used as raw materials
PERT = Total use of renewable primary energy resources
PENRE = Use of non-renewable primary energy resources excluding non-renewable energy resources used as raw materials
PENRM = Use of non-renewable primary energy resources used as raw materials
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
ND = Not Declared

OUTPUT FLOWS AND WASTE CATEGORIES per functional unit or declared unit (A1 / A2)

	UNIT	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
HWD	kg	6.55 E-4	2.55 E-5	4.47 E-4	1.13 E-3	4.35 E-4	1.53 E+0	0.00	0.00	0.00	0.00	0.00	2.23 E-4	1.37 E-4	2.62 E-5	1.98 E-6	-3.11 E-4
NHWD	kg	1.26 E-1	1.70 E-1	1.97 E-1	4.93 E-1	3.62 E+0	3.69 E-1	0.00	0.00	0.00	0.00	0.00	7.47 E-1	1.14 E+0	5.46 E-1	1.79 E+0	-4.59 E-2
RWD	kg	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CRU	kg	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MFR	kg	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MER	kg	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EEE	MJ	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EET	MJ	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

HWD = Hazardous Waste Disposed
RWD = Radioactive Waste Disposed
MFR = Materials for recycling
EEE = Exported Electrical Energy
ND = Not Declared

NHWD = Non Hazardous Waste Disposed
CRU = Components for reuse
MER = Materials for energy recovery
ETE = Exported Thermal Energy

CALCULATION RULES

Input and output data

In the LCA, all data is collected from the processes in the life cycle that fall within the system boundaries and related to so-called environmental interventions. Environmental interventions are "inputs from the environment" such as the extraction of raw materials and energy sources and "outputs to the environment" such as emission of CO2. In order to incorporate these environmental interventions into the LCA, data were collected on:

- raw materials;
- energy consumption;
- emissions to air, water and soil.

Allocation

Allocation is the distribution of environmental interventions among different products or processes. There are three types of processes in which allocation must take place namely multi-export, multi-import, and recycling and reuse processes. In these processes, emissions, waste, energy and energy and raw material consumption must be divided among multiple products or processes and a certain allocation key must be formulated. Allocation occurs in this LCA in the following processes:

- Production of different types of facing bricks

Allocation on a mass basis takes place in cases where several types of facing bricks are produced at one location of which one or more types are not included in the LCA. Allocation on a mass basis means that the share of emissions, energy consumption and other inputs to the product studied in the LCA is determined on the basis of the mass ratio of the various products. For facing brick and clay pavers in general different factories are involved. For the production sites where both facing bricks and clay pavers are manufactured, separate data for energy has been provided by TCKI for the different product groups. This has also led to the allocation of process data.

- Open-loop recycling of facing bricks after disposal

Brickwork is processed in the Netherlands as mixed granulate in the GWW sector. To do this, brickwork has to be crushed. The processing up to the economic tipping point is allocated to the production chain: the brick. Here the economic tipping point is at about half of the crushing process.

- Landfill and incineration processes of waste flows

These processes are multi-input processes, environmental effects such as leaching and emissions are determined on the basis of the chemical composition of the material to be landfilled or incinerated. In the case of incineration of plastic and wood in the waste scenario, restitution of electricity and heat is deducted from the product system as prescribed in the SBK assessment method.

Validation and data quality

Data was collected for energy consumption and emissions from the brick industry to perform the update of the LCA of facing bricks. This data was collected by TCKI with the base year 2017. Energy data is derived from the registration for multi-year agreements (MJA-3). In addition, gross consumption figures have been used to map the raw materials balance. All this data are measured at the company level. Where use is made of fixed values for background processes for energy generation, transport and waste processing processes, the guidelines from the SBK assessment method have been followed.

SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

The LCA includes the following phases of the facing bricks life cycle:

• Extraction of raw materials (A1);
• Transport to the production location (A2);
• Production of the facing bricks (A3);
• The transport of the facing bricks to the construction site (A4);
• Construction site processes. The environmental impacts of the use of mortar is included in A5. (A5);
• Use of facing bricks (B1);
• Maintenance, replacements, repairs (B2-5);
• Demolition (C1);
• Transport waste processing (C2);
• Waste processing (C3);
• Final waste processing (C4);
• Module (D).

At the end of the life cycle of facing bricks for outdoor applications, the material is processed according to the regular processing methods for construction materials. In most cases there is no reuse of the facing bricks. At the end of the life cycle, brickwork is transported to rubble crushers and ground into granulate that is reused in the civil engineering sector. The lump-sum waste scenario is used in which 1% of the bricks are disposed and 99% is crushed and recycled. The waste scenario is modelled as follows.

Demolition (C1)
For the exterior wall leaf, the process from the basic process database: "SBK Demolition average" was calculated based on the weight of the application (brick, masonry mortar and grout).

Transport to waste disposal (C2)
50 km per truck to a crushing/sorting site was used.

Waste processing (C3)
The crushing process according to: SBK Crushing stony materials MRPI - NMD* v3.0. This is applied based on the weight of the application (brick, masonry mortar and grout). In this process, the entire crushing process is allocated to the waste disposal of brick. The raw material equivalent of crushed masonry is masonry granulate (see Module D).

Final waste processing (C4)

The disposal of 1% of the part that is not reused of the application according to:
0247-sto & Landfill inert waste (based on Inert waste, for final disposal {RoW} | treatment of inert waste, inert material landfill | Cut-off, U) fine / coarse ceramic, gravel, sand-lime brick, shells, sand - NMD* v3.0. transport to the landfill is taken 50 km by truck.

Module D, raw material equivalent and net output flow

In accordance with the SBK Assessment Method, all waste processing has been allocated to facing brick. In this crushing process, a new raw material, masonry granulate, is created that can be used as an unbound stone mixture. The raw material equivalent of this is crushed stone. Since the bricks are (almost) entirely made of primary material (clay). For every kg of masonry that goes into the product system, one kg of crushed stone can be deducted from the product system minus the losses in the crushing process. This loss is set at 1% in accordance with the lump-sum waste processing scenarios from the determination method. The avoided production of primary crushed stone is modelled on the basis of 0205-fab&Crushed stone, quarry (NVLB: A3) (based on only Diesel, burned in building machine {GLO}| processing | Cut-off, U) - NMD* v3.0.

* *NMD = Nationale Milieu Database (Dutch Environmental Database)*

DECLARATION OF SVHC

Facing bricks do not emit substances or gases that are harmful to human health or the environment.

REFERENCES

• Stichting Bouwkwaliteit, Bepalingsmethode Milieuprestatie Gebouwen en GWW Werken;
• B. Roijen, Update LCA Baksteen, A895710/R20180391, juli 2019.

REMARKS

QUALITATIVE INFORMATION:

The value of the Dutch environmental cost indicator (MKI) over the entire life cycle (modules A to D) is € 2,88 per 1 m² brickwork (thickness 100 mm, facing bricks and mortar).

An important side effect of the extraction of river clay is the limitation of the danger of flooding. The clay extraction lowers the flood plains (space for river water) and contributes to river safety. Over the centuries it has been proven that facing bricks have a very long life.