Environmental Product Declaration

according to ISO 14025

TONALITY®
Ceramic cladding elements

CREATON AG

Declaration number
EPD-CRE-2009111-E

Institut Bauen und Umwelt e.V.

GERMAN INSTITUTE CONSTRUCTION AND ENVIRONMENT e.V.
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Abstract

Environmental Product-Declaration

GERMAN INSTITUTE CONSTRUCTION AND ENVIRONMENT

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Programme holder

CREATON AG
Dillinger Straße 60
D-86637 Wertingen

Declaration holder

EPD-CRE-2009111-E

Declaration number

TONALITY® Ceramic cladding elements

This declaration is an environmental product declaration according to ISO 14025 and describes the specific environmental impacts of the mentioned construction materials in Germany. It is supposed to advance the development of environmentally and health friendly construction. All relevant environmental data is revealed in this validated declaration.

The declaration is based on the PCR document „Ceramic sheathing materials: 2008-07“.

Declared building products

This validated declaration entitles the usage of the label of the German Institute Construction and Environment.
This exclusively applies to the mentioned products, three years from the date of issue.
The declaration holder is liable for the basic information and verifications.

Validity

The **declaration** is complete and contains in detailed form:

- Product definition and information about building physics
- Information about basic material and the material's origin
- Description of the product's manufacture
- Indication of product processing
- Information about the in-use conditions, extraordinary impacts and subsequent usage phase
- Life cycle assessment results
- Testings and verifications

Content of the Declaration

08th January 2009

Date of issue

Prof. Dr.-Ing. Horst J. Bossenmayer (Chairman of the German Institute Construction and Environment)

Signatures

This declaration, and the rules which it is based on, have been verified by the Independent Advisory Board (SVA) according to ISO 14025.

Verification of the declaration

Prof. Dr.-Ing. Hans-Wolf Reinhardt (Chairman of SVA)

Dr. Werner (Reviewer appointed by the SVA)

Signatures

Summary

Environmental Product-Declaration

Product description

„TONALITY®“ elements flat ceramic cladding panels made of clay. The panels are manufactured from various clay masses and obtain their surfaces and their colours through coordinated incineration charts. “TONALITY®” elements are single-leaf panels as well as non-bearing panels with cavities for claddings of external walls ventilated at rear.

The cladding panels are tethered to load bearing systems of the cladding via system bound aluminium substructures. The manufacture is carried out according to DIN EN 1304.

Range of application

„TONALITY®“ is applied as sheathing material for non-bearing claddings of external walls ventilated at rear as well as for decorative interior fittings. The cladding panels are also applied for suspended ceilings, embrasures and covering.

Scope of the Life Cycle Assessment

The LCA was performed according to DIN ISO 14040 ff. corresponding to the requirements of the guide lines concerning Type III declarations of the German Institute Construction and Environment. Specific industrial data of the cladding centre Weroth as well as data from the data base „GaBi 4“ was applied as data basis. The LCA comprises raw material and energy production, raw material transports and the actual manufacture phase of the ceramic cladding elements as well as the recycling and/or disposal of the cladding system right after expiry of the life cycle whilst considering the recycling potential. A 1 m² of an average TONALITY® - cladding element including a system bound subconstruction was examined.

LCA results

TONALITY® Ceramic cladding elements including a sub-structure				
Assessment parameter in unit per m²	**Total**	**Cladding panel**	**Aluminium-profile**	**End-of-Life**
Primary energy, non renewable [MJ]	**422**	366	147	-91
Primary energy, renewable [MJ]	**14,66**	7,88	43,15	-36,37
Global Warming Potential (GWP 100) [kg CO2-equ.]	**26,9**	22,8	11,8	-7,7
Ozone Depletion Potential (ODP) [kg R11-equ.]	**1,25E-06**	9,43E-07	8,52E-07	-5,49E-07
Acidification Potential (AP) [kg SO2- equ.]	**0,047**	0,031	0,053	-0,037
Eutrophication Potential (EP) [kg PO4- equ.]	**4,69E-03**	3,41E-03	2,32E-03	-1,04E-03
Photochemical Ozone Creation Potential (POCP) [kg C2H4- equ.]	**4,26E-03**	2,84E-03	5,07E-03	-3,64E-03

Created by: PE INTERNATIONAL, Leinfelden-Echterdingen

PE INTERNATIONAL
EXPERTS IN SUSTAINABILITY

Testing and verifications

In addition, the results of the following testings are presented in the Environmental Product Declaration:

- Leaching behaviour
- Radioactivity

Scope of validity This environmental product declaration refers to ceramic cladding panels of the mentioned composition of the factory Weroth lead by the CREATON AG with the trademark TONALITY®.

0 Product definition

Product definition „TONALITY®“ are flat ceramic cladding panels made of clay. The panels are manufactured from various clay masses and obtain their surfaces and their colours through coordinated incineration charts. These are single-leaf panels as well as non-bearing panels with cavities for claddings of external walls ventilated at rear.

The cladding panels are tethered to load bearing systems of the cladding via system bound aluminium substructures. The manufacture is carried out according to DIN EN 1304.

Application „TONALITY®“ is applied as sheathing material in non-bearing claddings of external walls ventilated at rear as well as for decorative interior fittings. The cladding panels are also applied for suspended ceilings, embrasures and covering.

Product standard / approval DIN EN 1304 Clay roofing tiles and fittings
General approval of the building authorities No. Z-33.1-567 for non-bearing claddings of external walls ventilated at rear of the German Institute for Structural Engineering (Deutsches Institut für Bautechnik) CREATON Fassade „TONALITY®“.

Quality control Quality assurance acc.to DIN ISO 9001
CE- declaration of conformity according to paragraph ZA.3 of the DIN EN 1304
External control of the product according to the approval of the building authorities by the IFBT Leipzig.

Geometrical data Dimensions of the cladding panels „TONALITY®“ accord. to authorisation No. Z-33.1-567:

Dimensions of the deliverable panels

Height:	150 mm	lengths:	400 – 800 mm
Height:	175 mm	lengths:	400 – 800 mm
Height:	200 mm	lengths:	400 – 1.200 mm
Height:	250 mm	lengths:	400 – 1.200 mm
Height:	300 mm	lengths:	400 – 1.200 mm

Building physical data

Bulk density:	2,24 g/cm²
Breaking strength:	470 kN/m acc. to DIN EN 10545-4
Heat conductivity:	1,17W/mK acc. to DIN EN 60672-2 (90°)
Water absorption:	on the basis of DIN 539-2 Method B (24 hours)
	Boundary values 3-5% acc. to DIN 10545-12

Fire prevention Fire protection classification: class A1 acc. to DIN 4102, Teil 1
Classification of building materials acc. to DIN EN 13501 A1, s0 – d0.

1 Basic materials

Raw materials/ Aggregates

- Clay	40 - 70 %
- Grog	20 - 35 %
- Water	20 %
- Colour pigments in the mass	1 -3 %
- Colour coating on the surface	0 -2 %

Auxiliary materials/ Additives

Packaging materials (shrink film made of polyethylene, multipurpose wooden pallets) serve as auxiliary materials. Further additives and substances are not applied here.

Commentary on materials

Clays: are weathering products of rocks containing feldspar. Clay is mined in the open mining and processed according to its composition.

The clay applied here has a sulfur content of 40-50 ppm. The mining of clay is accomplished by observance of legal requirements and approvals. Recultivation and restoration of the open mining areas are guaranteed for after completion.

Grog: are fired and ground clays which are sieved. Comprehensive measures for the containment of noise and dust emissions during the manufacturing process have been taken.

Water: is withdrawn from the public pipe network. Sewage is treated and then further used as process water.

Colour pigments: are used in mass and glazing. The raw materials are metal oxides which are intercalated in the process, glowing (at 1200°C). These are products which do not contribute to the ecological and toxicological problems practically being inert materials. Through the integration in the grid, the metal oxides lose their primary chemical, physiological and physical characteristics completely.

Portachrome: is a natural mineralogical colouring oxide.

Engobe: is a porous and/or more dense surface layer on the basis of clay /DIN EN 1304/.

Glazing: is a baked surface layer on the basis of glass /DIN EN 1304/.

Raw material extraction and origin

The clays and grogs come from sources from the Westerwald, in the proximity of the factory's location and which are processed by the firms "WBB Fuchs" and "Goerg und Schneider". Recultivation and restoration of the open mining areas are guaranteed for after completion. The applied glazing also comes from the proximity of the factory's location.

Regional and general availability of raw materials

Mineral substances such as clay generally are of limited availability. However, there is no scarceness of these resources. The clay deposits in the Westerwald are limited due to their geology; however, our suppliers are making an effort of ensuring the availability of raw material for the following generations. This occurs with the help of drillings and continuous examination of the deposits.

2 Product manufacture

Manufacturing the building product

Conditioning process:

The raw material components are dosed and homogenised during conditioning. In this area initial examinations of the raw materials are conducted e.g. determination of the mass moisture.

Furthermore, a constant monitoring specifically of the facility's wear and tear parts takes place. Noise and dust emissions being an environmental impact are measured in regular intervals and evaluated by external testing laboratories.

Shaping process:

In this area, the ceramic mass is given the desired shape by pulling it in strands. After the shaping, optical surface controls of precise contours for example are continuously accomplished. The mass moisture is controlled every hour. The facilities and equipment assemblies are subjects to permanent monitoring as is the automatic low pressure control of the vacuum chamber for example.

The waste oil accumulated by the vacuum generation via grease extractors as well as by other processes is professionally disposed of.

Drying process:

The shaped claddings have a defined water content due to the ductile moulding which is cast out during the drying process on regulated conditions. The drying progress is examined through measurements of the residual moisture. If required, a fault analysis is carried out after the drying. Natural gas is consumed during the drying process. The emissions accumulated are water and carbon dioxide.

Surface refining process:

Depending on the production contract, a refining of the surface is accomplished through an engobe or glazing coating after the drying process. Engobe and glass sludge resulting from the surface refining are lead to a separate conditioning.

Burning process:

Subsequently, the burning process follows after the drying process and if necessary the surface refining. It adds the characteristics to the cladding bricks according to our technical construction licence and our CREATON norm.

Natural gas is consumed during the burning process. The emissions accumulated are water, carbon dioxide, sulphur dioxide and hydrofluoric acid which are rinsed in our flue gas facility so that the values required in the licensing notice are below the limit.

Sorting and packaging process:

An optical examination of the cladding bricks is randomly accomplished in this area. Furthermore, length and height of the cladding bricks as well as the system sizes of the cladding bricks are randomly checked by measurement. A further important criterion for the examination is the water adsorptive capacity.

The waste cuttings are collected and professionally processed into grogs through grinding by an external company.

Then the packaging of the claddings takes place; these are wrapped in customer and environmentally friendly mini parcels on euro-pallets. The packaging facilities are operated with compressed air. The production of compressed air is energetically intensive and associated with the generation of oil condensate mixtures.

Health protection Manufacture

The body of rules and regulations of the employers' mutual insurance association applies. No special measures need to be taken for the protection of the employees, health.

Environmental protection Manufacture

Air:
The emissions from the burning process are situated beneath the limit values of the technical instructions on air quality (TA Luft). Measurements of the environmental protection are aimed at energy consumption as low as possible and a low pollutant discharged air.
Measures for decreasing emission encompass: post burning of the sulphur gases; installation of additional filters; choice of fuels which contribute to the reduction of CO_2 (natural gas for example); improvement of conducting the fire via computer-assisted optimisation. Yearly measurements of the HF concentration in fumes.

Water/ soil:
Contamination of water and soil do not occur. The process runs effluent free. The applied batching water is released during the drying process as water vapour. Lavation water is treated and inserted back into the water cycle (water is used for cutting the panels).

Noise:

Due to internal industrial measures for noise control, the noise immissions are considerably beneath the thresholds of the technical instructions on air quality (TA Luft).

3 Product processing

Processing recommendations

The assembly of the cladding elements is accomplished by a system bound sub-construction. The assembly instructions are to be considered compliant to the approval of the building authorities. During assembly, it has to be considered that the described characteristics of the compatibilty of environment and health of ceramic cladding elements are not influenced negatively.

Special cutting equipment as is used for cutting ceramic tiles is available for the operation. The wet saws possess diamond cutting wheels cooled by water which binds the dust from the cutting at the same time.

Drillings into the ceramic can be accomplished with diamond set masonry drills.

Disc saws equiped with hard metal or manually operated saws can be applied for trimming the system bound aluminium sub-construction. Conventional HSS drills can be used for drilling into aluminium profiles of the system's sub-construction.

The ceramic panels are secured mechanically by hooks in the sub-construction of the system and by the ceramic reverse of the cladding panels and do not require any further mechanical fasteners or screws.

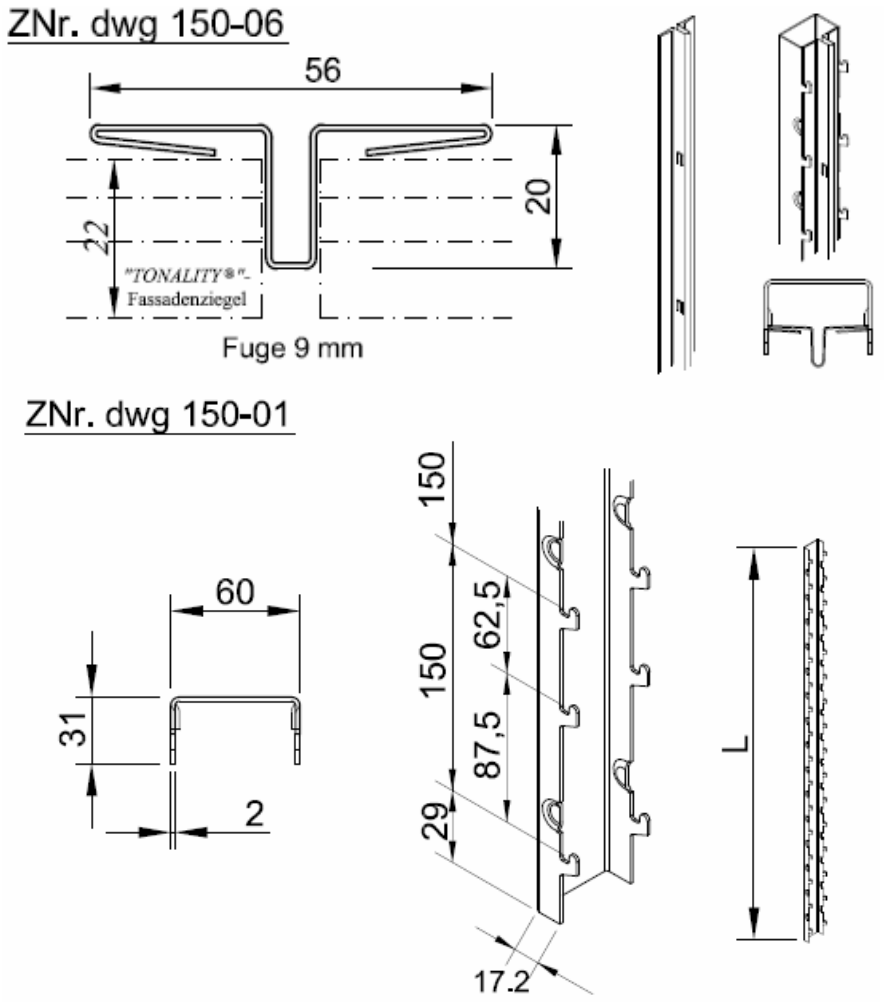

Figure 3-1: **Sub-construction for the fastening of the ceramic cladding panels, splice profile (above) and vertical profile (below) [CREATON AG]**

Industrial safety / Environmental protection

The weights of the single elements are beneath the recommendations of the buidling trade association. Safety measures according to the rules and standards of the trade association and corresponding to the recommendations of the manufacturers are to be followed during the processing of the cladding elements. For cutting and splitting works, wet methods are normally required. In case of dust development during work a dust mask has to be worn.

Residual material

Cladding element remains are to be seperately collected at the building site. Cladding element remains can be disposed of on class I dumps with the waste key number 17.01.02. The aluminium profiles can be disposed of as recyclable waste or as building and demolition waste with the waste key number 17.04.02.

Packaging

The polyethylene shrinking foils are recyclable. Non contaminated PE foils and reusable pallets made of wood are taken back by the construction traders (reusable pallets for reimbursement in the deposit system) and then given back to the manufacturers, they pass the foils on to the foil manufacterers for recycling purposes.

Cladding element remains can also be taken back by the manufacturers and used as raw material or disposed of on class I dumps.

4 In-use conditions

Contents The substances of the panels are bound as solid material during the entire service life (ceramic bond).

Impact relations Environment – health Ceramic cladding elements do not emit any environmental and health hazardous substances. The natural ionising radiation of the cladding panels is extremely low and harmless to health. (See chapter 8.1 Radioactivity)

Durability / Utilisation condition Ceramic cladding elements do not alter after leaving the tunnel furnace. They are infinitly durable when applied in its designated use. The cladding elements are weather resistant according to DIN EN ISO 10545, according to DIN EN ISO 10545-4 frost resistant, acid and lyeproof.

5 Extraordinary impacts

Fire In case of fire no toxic gases and vapours influencing visibility can develop. The mentioned products meet the demands of DIN EN 13501.

Water Due to solid, ceramic bonds, no water contaminating substances can be elutriated.

6 End of Life

Reutilisation The durability period of ceramic cladding elements is normally above the optical usage phase of the cladding.

Depending on their mass, panels can be reused according to their originally intended use in case of specific dismantling of buildings.

Subsequent use Cladding elements resulting from the dismantling procedure can be reused for constructional elements with less visual demands.

Recycling Leftovers of homogenuous elements can be taken back by the grog manufacturers and recycled as nonplastic materials in a grinded form in the production. This has been practised for broken panels for decades.

Subsequent recycling Possibilities of subsequent recycling exist as aggregate (chiselled bricks) for concrete, as filling material in road and underground construction, in building anti-noise barriers as well as tennis powder.

Disposal / dumping Element leftovers, fractured products as well as elements from demolition and dismantling procedures which accumulate at the buidling site are easily disposable and do not present any exceptional pollutions for the environment provided that the above mentioned recycling possibilties are not practicable.

Waste key number: 31409 (construction rubble / Bauschutt) according to LAGA-Waste type catalogue; 170102 (bricks) according to the European Waste Type Catalogue.

The dump capability of cladding elements according to class I corresponding to the technical instructions on municipal waste (TA Siedlungsabfall) is ensured. Due to the chemically neutral, inert and immobile behaviour of the cladding elements, these can be stored in dumps of dump class I.

Sub-construction Depending on their masses, the aluminium profiles of the sub-construction can be recycled or reused according to their originally intended use in case of specific dismantling of buildings.

7 Life cycle assessment

The declaration refers to the life cycle of one square meter of ceramic cladding panels including the system bound aluminium sub-construction.

Declared unit

The life cycle assessment is performed for an average ceramic cladding panel with a density of about 2 tons per m³. A square meter of cladding panel (without sub-construction) weighs about 31 kg.

One running meter of the aluminium profile (AlMg3, powder coated) with the weight of 0,9 kg per running meter is needed for fastening a square meter of cladding panel /CREATON AG 2008/.

System boundaries

The life cycle analysis of the examined cladding panels comprises the life cycle phases cradle to grave. It starts with the consideration of the raw material production (particularly clay) and the subsequent processing (grog), the manufacture of the applied raw materials and additives and the panel production itself. Furthermore, the manufacture of the applied aluminium profile as well as its upstream processes are enclosed. The usage phase is not considered in this declaration and needs to be completed for an evaluation or a comparison in context with the buidling. In the End-of-Life (EoL), dumping the cladding panel is expected and recycling of the inserted aluminium profile is assumed. The recycling potential for aluminium and the EoL are included in the life cycle assessment.

7.1 Manufacturing the ceramic cladding elements

Cutt-off criteria

All material flows of the input side contributing to the system and larger than 1% of their total mass or contributing more than 1% to the primary energy consumption, were considered. All material flows leaving the system and which environmental impacts were larger than 1% of the entire impacts of the considered impact categories were entered on the output side.

The manufacture of the machines, facilities and infrastructure needed for the manufacture of the products is neglected.

Transportation

Transports in the upstream processes are considered. Transportations to the building site are not considered.

Observation period

The data basis for the present life cycle assessment is provided by data collections of the panel manufacture in the cladding centre of Weroth from 2007. Data of the clay (“WBB Fuchs”) and grog suppliers (“Goerg und Schneider”) were also acquired. These are also based on 2007/2008. Measurements of HF and dust emissions were carried out in 2005. The process of aluminium profile manufacture originates from the data base of the GaBi 4 software from 2002 after the technology comparison with the manufacturer.

Background data

For the modelling of the life cycle for the manufacture of the examined ceramic cladding panels as well as of the sub-construction, the software system for holistic balancing "GaBi 4" created by PE INTERNATIONAL GmbH was applied /GaBi 4/. All background data sets relevant for the product development were extracted from the data base of the GaBi 4 software or provided by CREATON AG and their suppliers.

Data quality

The last revision of the applied data occured less than 6 years ago.

Allocation

The examined sub-construction is an aluminium profile which consists of primary aluminium by 100%.

The recycling potential of the aluminium profile was calculated according to the requirements of the IBU guideline /IBU 2006/.

It describes the ecological value of the accumulation of the material in the technosphere. It indicates how many environmental burdens can be reduced in comparison

to the newly production of the material (in this case: avoidance of primary aluminium production). The collection quota of scrap aluminium is assumed to be 90% [EMPA 2008], for the preparation and fusing, the quota of 96,4% [EAA 2008]. The recycling of metal is accomplished according to the technologies of today.

The recycling potential is a matter of economisation in manufacturing and consists of a data set with multiple parameters for this reason. In case the entire recycling potential is made use of, the values of manufacture are reduced by the values for the recycling potential.

Information about the utilisation phase

The lifetime of building products depends on the prevailing construction, the usage and maintenance of the building.

7.2 Subsequent use phase

General

The EoL of the cladding system is additionally considered: the recycling of the aluminium sub-construction and the dumping of the cladding panels on a landfill for inert matter. The examined processes are the state of the art and are used widely.

Dump efforts and recycling credits

The impacts and credits from the recycling potential are displayed as “EoL” as total sum in the respective columns of the chart. The impacts of the disposal processes are very low. The credits for the recycling potential dominate the sum of the EoL..

7.3 Demonstrating the balances and analysis

Life cycle inventory analysis

The life cycle inventory analysis regarding the primary energy consumption, water consumption and waste is presented in the following chapters.

Primary energy consumption

The following table shows the primary energy consumption during the life cycle of 1 m² ceramic cladding panels as well as the primary energy consumption of the partial sub-construction.

Table 7-1: Implementation of primary energy sources during the life cycle of 1 m² ceramic cladding panels including the sub-construction in [MJ / m²]

TONALITY® Ceramic cladding elements including a sub-construction				
Assessment parameter	Cladding panel	Aluminium profile	EoL	Total
Primary energy, non renewable [MJ / m²]	366	147	-90,7	**422**
Primary energy, renewable [MJ / m²]	7,88	43,15	-36,37	**14,66**

The consumption of non renewable energy during the manufacture of 1 m² ceramic cladding panel amounts to 366 MJ, plus 147 MJ for the sub-construction. Within the analysis of the subsequent usage phase, a credit of ca. 91 MJ resulted. These are composed as sum of the credit of the recycling potential (-97 MJ) and the impacts of the disposal of the cladding panel at the EoL (6 MJ).

About 28% of the 366 MJ of fossil primary energy of the cladding panel mentioned are allotted to raw materials, 70% to the panel production, particularly to the energy consumption of the burning process, and 2% to the packaging.

15 MJ of renewable energy are additionally consumed during the life cycle of 1 m² cladding panel including the sub-construction. The largest part of this results from the

upstream process of the aluminium profile which is "credited" as future reduction within the recycling potential. The required respectively "saved" electricity is largely based on renewable energies from the electricity mix. Furthermore, the wooden paddings and covering which serve as packaging material for the panel contribute to renewable energies. The rate of disposal of the cladding panels is marginal in the EoL.

Secondary fuels

Secondary fuels are not applied during the life cycle of the ceramic cladding panels.

In figure 7-2 the closer evaluation of the primary energy demand for the life cycle of 1 m² ceramic cladding panels including the sub-construction show that natural gas is used predominantly as non-renewable primary energy source and that hydro power dominates the used renewable energies.

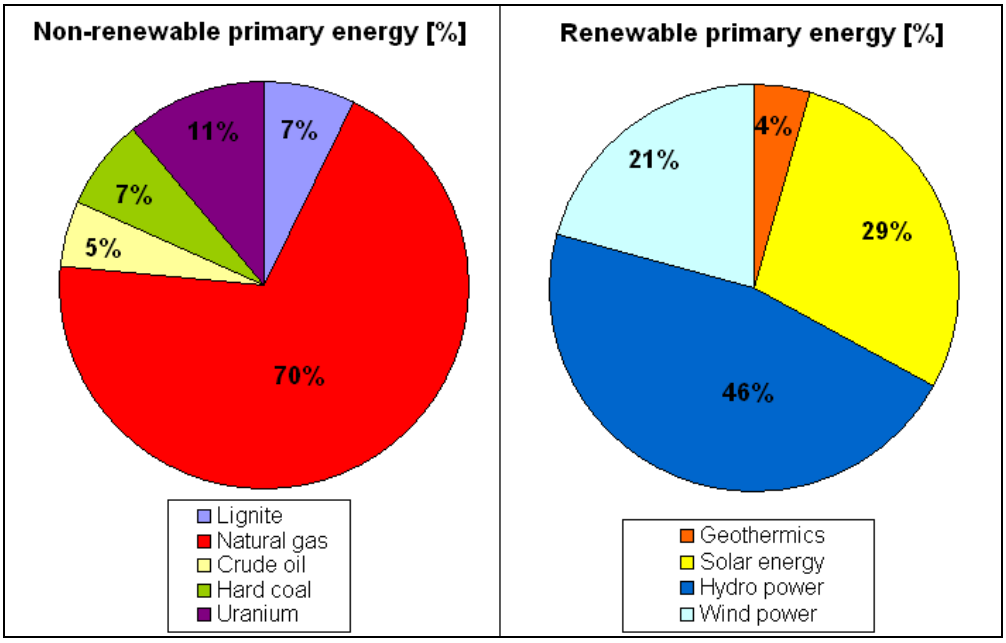

Figure 7-2: **Distribution of the consumption of renewable and non renewable primary energy during the life cycle of 1 m² ceramic cladding panels including the sub-construction**

Water use

During the life cycle of 1 m² ceramic cladding panels including the sub-construction and upstream processes, 0,14 m³ of water are required (Table 7-2).

Table 7-2: **Water use during the life cycle of 1 m² ceramic cladding panels including the sub-construction**

TONALITY® Ceramic cladding elements including a sub-construction					
Assessment parameter	Unit per m²	Cladding panel	Aluminium profile	EoL	Total
Water input	[kg]	84	100	-40	**144**

About 16% of the 0,084 m³ water of the cladding panel result from the actual manufacturing process of the ceramic cladding panels and 50% from the upstream processes of the electricity supply.

Material resources

Used non renewable material resources mainly represent clay, non-exploitable rock, soil and chrome ore (Table 7-3).

Table 7-3: Use of non renewable material resources during the life cycle of 1 m² ceramic cladding panels including the sub-construction

TONALITY® Ceramic cladding elements including a sub-construction					
Material Resource	Unit per m²	Cladding panel	Aluminium profile	EoL	Total
Bauxite	[kg]	0,04	3,98	-3,51	**0,5**
Soil	[kg]	9,34	0,06	0,37	**9,8**
Chrome ore	[kg]	5,18	0,05	-4,7E-05	**5,2**
Iron ore	[kg]	0,03	0,02	-0,01	**0,04**
Non-exploitable rock	[kg]	32,0	23,7	-14,0	**41,7**
Clay	[kg]	41,4	0,001	1,04	**42,6**

The rate of non-exploitable rock is primarily ascribed to the extraction of energy sources for the power generation. During the mining of clay, soil is mainly accumulated.

Waste

The analysis of the waste accumulation is demonstrated in three separate fractions: rubble/dump commodities (including residues from the ore processing), municipal waste (household garbage and industrial waste are included here) and hazardous waste including radioactive waste (Table 7-4).

Rubble is represents the greatest amount of the **dump flows**. Rubble mainly accumulates during the upstream process of the power generation and during the mining of clay. 32 kg of dump flows originate from the disposal of the ceramic cladding panel at the EoL. The 19 kg remaining (Table 7-4) result from the recycling credit, respectively the reductions of the 32 kg due to the recycling potential.

Hazardous wastes are mainly wastes from upstream processes, 20 % of it is radioactive waste (exclusively due to the power generation in nuclear power plants).

The following table shows the waste accumulation during the life cycle of 1 m² of ceramic cladding panels as well as the proportional sub-construction.

Table 7-4: Waste accumulation during the life cycle of 1 m² ceramic cladding panels including the sub-construction

TONALITY® Ceramic cladding elements including a sub-construction					
Assessment parameter	Unit per m²	Cladding panel	Aluminium profile	EoL	Total
rubble/ dump commodities	[kg]	46	24	19	**89**
municipal waste	[kg]	0,03	0,06	0,05	**0,14**
hazardous waste	[kg]	0,05	0,08	-0,05	**0,08**

Impact assessment

Table 7-5 represents the contributions of the manufacture of ceramic cladding panels, the manufacture of the sub-construction as well as the contributions of the EoL to the impact categories Global Warming Potential, Ozone Depletion Potential, Acidification Potential, Eutrophication Potential and Photochemical Ozone Creation Potential.

The recycling potential of the proportional aluminium sub-construction are also displayed.

Table 7-5: Results of the impact assessment during the life cycle of 1 m² ceramic cladding panels including the sub-construction

TONALITY® Ceramic cladding elements including a sub-construction						
Assessment parameter	Unit per m²	Cladding panel	Aluminium profile	EoL panel	Recycling potential	Total
Global Warming Potential (GWP)	[kg CO_2-equ.]	22,8	11,8	0,7	-8,4	**26,9**
Ozone Depletion Potential (ODP)	[kg R11-equ.]	9,43E-07	8,52E-07	5,26E-07	-5,54E-07	**1,25E-06**
Acidification Potential (AP)	[kg SO_2-equ.]	0,031	0,053	3,03E-03	-0,040	**0,047**
Eutrophication Potential (EP)	[kg PO_4-equ.]	3,41E-03	2,32E-03	4,21E-04	-1,46E-03	**4,69E-03**
Photochemical Ozone Creation Potential (POCP)	[kg Ethen-equ.]	2,84E-03	5,07E-03	4,43E-04	-4,09E-03	**4,26E-03**

Figure 7-3 exemplifies the relative contributions of each category to the analysed impact categories. In this case the manufacture of the cladding panels is divided into the categories “Raw materials for panels”, “Panel production”, “Transports” and “Packaging”. Furthermore, the category “EoL panels” represents the influences of the disposal of the cladding panel.

As the manufacture of the aluminium sub-construction dominates the other categories in such a manner, that their impacts would hardly be noticeable, the credit for the recycling potential are already added to the impacts of the production of the aluminium profile. The category „Subcon. incl. Recycling Potential“ contains the sum of the impacts for the manufacture of the aluminium profile and the credits (negative values) for the recycling potential.

The dominant influence of the production process appears in all impact categories: With 43% for the POCP, 48% for the EP, 45% for the AP, 56% for the ODP and 61% for the Global Warming Potential. The environmental effects of the panel production are determined by the operation of energy sources (gas, electricity).

The raw materials cause about one fifth of the presented environmental effects; 19% of the POCP and ODP and 21% of the EP. These contribute with 23% to the GWP which can be especially retraced to the fuel input of the grog burning process. The grog manufacture also dominates the ODP, AP, EP and POCP of the raw materials.

The influence of the aluminium profile (manufacture – recycling potential) in the acidification potential is most considerable with its 27%.

The influence of the disposal of the cladding panel in the EoL appears distinctly in the POCP and EP each with about 10%. Packaging and transport are of minor importance.

Impact assessment

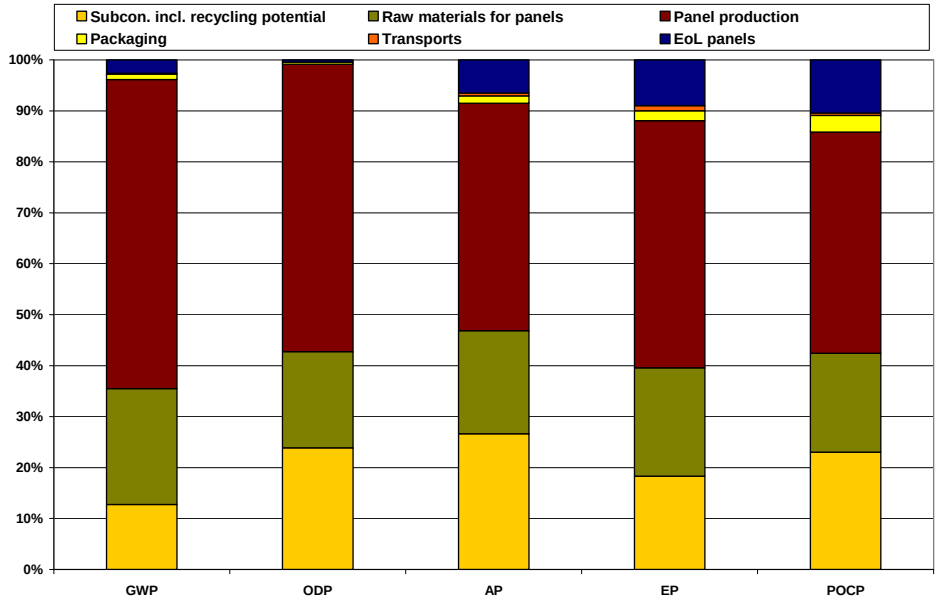

Figure 7-3: **Relative contributions of individual categories to environmental impacts (GWP, ODP, AP, EP and POCP) during the life cycle of 1 m² ceramic cladding panels including a sub-construction with regard to the recycling potential.**

8 Testing and verifications

8.1 Radioactivity

Measuring institution: Umweltinstitut München e.V. (Environmental Institute), control reports from 04th May 2005.

Procedure: Examination of cladding tiles from the Weroth factory, determination of the ACI (Activity Concentration Index), measurement of the nuclide content in Bq/kg for lead-212, lead-214, potassium-40, iodine-131, Caesium-134, Caesium-137

The measured values are smaller than the ACI. All mineral elements contain small amounts of natural radioactive substances. The measurements show that the natural radioactivity of cladding tiles is harmless from the radiologic view /UIM 2005/.

8.2 Leaching behaviour

Measuring institution: MPVA Neuwied GmbH, control reports from 04th August 2008.

Procedure: Determination of the eluate values according to DIN 38414-4 for brick-red shards with glazing (refined as brick-red)

The rate of elutriatable components lies beneath the boundary values. Emissions of solutions or emulsions are not possible due to entirely waterproof bonds of the substances. Endangerments for water, air and soil can not arise /MPVA 2008/.

9 PCR-Document and Verification

This declaration is compliant to the PCR Document Ceramic Sheathing 2008-07.

Review of the PCR Document through the Independent Advisory Board (SVA). Chairman of the SVA: Prof. Dr.-Ing. Hans-Wolf Reinhardt (University Stuttgart, IWB)
Independent verification of the declaration according to ISO 14025: ☐ internal ☒ external
Validation of the declaration: Dr. Werner

10 Literature

/Blechform 2008/	Blechform A + C Brandenburg GmbH, Fürstenwalde, 2008
/BREF 2006 /	Reference Document on Best Available Techniques in Ceramic Manufacturing Industry, Joint Research Centre, Sevilla, 2006
/CREATON 2008/	CREATON AG, www.creaton.de, 2008
/IBU 2006/	Leitfaden (Ausgabe 20.01.2006) für die Formulierung der produktgruppen-spezifischen Anforderungen der Umwelt-Produktdeklarationen (Typ III) für Bauprodukte, Institut Bauen und Umwelt e.V., www.bau-umwelt.com
/DIN EN 1304/	DIN EN 1304 Clay roofing tiles and fittings – product definitions and specifications; 2005
/DIN EN 13501/	DIN EN 13501Fire classification of construction products and building elements, 2007
/DIN EN 10545-1/	DIN EN 10545-1 Ceramic tiles – Part 1: Sampling and basis for acceptance, 1997
/DIN EN 10545-2/	DIN EN 10545-2 Ceramic tiles – Part 2: Determination of dimensions and surface quality, 1997
/DIN EN 10545-3/	DIN EN 10545-3 Ceramic tiles – Part 3: Determination of water absorption, apparent porosity, apparent relative density and bulk density, 1997
/DIN EN 10545-4/	DIN EN 10545-4 Ceramic tiles – Part 4: Determination of modulus of rupture and breaking strength, 1997
/EAA 2008/	European Aluminium Association: Environmental profile report - Semi-finished aluminium products and process scrap recycling, 2005
/EMPA 2008/	EMPA Eidgenössische Materialprüfungs- und Forschungsanstalt: Graue Energie von Bauprodukten aus Aluminium unter Berücksichtigung der wertkorrigierten Allokation, Dübendorf, 2008
/Eyerer 2000/	Eyerer, P. und Reinhardt, H.W. (Hrsg.): Ökologische Bilanzierung von Baustoffen und Gebäuden — Wege zu einer ganzheitlichen Betrachtung. Birkhäuser Verlag Zürich, 2000
/GaBi 4/	GaBi 4: Software and data base for holistic balancing. LBP, University Stuttgart and PE International GmbH, 2001-2008.
/G & S 2008/	Goerg und Schneider GmbH u. Co. KG, Tone - Schamotte – Massen, Bahnhofstrasse 4, D-56427, Siershahn, , www.goerg-schneider.de/frame.htm, 2008
/ISO 14020/	DIN EN ISO 14020: Environmental labels and declarations – General principles, 2001
/ISO 14025/	DIN EN ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures, 2006
/ISO 14040/	DIN EN ISO 14040: Environmental management - Life cycle assessment - Principles and framework, 2006
/ISO 14044/	DIN EN ISO 14044: Environmental management - Life cycle assessment - Requirements and guidelines, 2006
/MPVA 2008/	Materialprüfungs- und Versuchsanstalt Neuwied, Prüfbericht: – Untersuchung von Keramik hinsichtlich des Auslaugverhaltens, Prüfzeichen 70/1024/08, 04.08.2008
/MSDS 2002/	Sicherheitsdatenblatt Portachrom, Konform 2001/58/EG und ISO 11014-1, Fassung 001.00.00, zusammengestellt der Fa. Royal Haskoning, Nijmegen/Niederlande, 09.08.2002
/PCR 2008/	PCR Keramische Bekleidung: Regeln für die Produktdeklaration – Keramische Bekleidung, Juli, 2008
/UIM 2005/	Umweltinstitut München e.V, Prüfbericht Fassadenziegel – Untersuchung auf natürliche und künstliche Radioaktivität, Durchführung K. Wurzbacher, Mai 2005
/WBB Fuchs 2008/	WBB Fuchs GmbH, Keramische Massen, Sälzerstraße 20, D-56235 Ransbach-Baumbach, www.wbbminerals.com, 2008

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In case of doubt the original Environmental Product Declaration “EPD-CRE-2009111-D” is applicable.
The CREATON AG is responsible for the translation.