# ENVIRONMENTAL PRODUCT DECLARATION
in accordance with ISO 14025

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| Declaration holder | ROTEC GmbH & Co. KG |
| Publisher | Institut Bauen und Umwelt (IBU) |
| Programme holder | Institut Bauen und Umwelt (IBU) |
| Declaration number | EPD-ROT-2012111-D |

**ROTOCELL & ROTOCELL plus pumice granulate**

**ROTEC GmbH & Co. KG**

www.bau-umwelt.com

Institut Bauen
und Umwelt e.V.

# 1 General information

**ROTEC GmbH & Co. KG**

**Pumice granulate**
**ROTOCELL & ROTOCELL plus**

**Programme holder**
IBU - Institut Bauen und Umwelt e.V.
Rheinallee 108
D-53639 Königswinter

**Owner of the Declaration**
ROTEC GmbH & Co. KG
Eisenbahnstraße 12
D-56218 Mülheim-Kärlich

**Declaration number**
EPD-ROT-2012111-D

**Declared product/unit**
1 tonne ROTOCELL & 1 tonne ROTOCELL plus

**This Declaration is based on the Product Category Rules:**
Lightweight aggregates / Bulk granulate, 11-2011
(PCR-tested and approved by the independent Expert Committee)

**Area of applicability:**
Within the Environmental Product Declaration, the environmental parameters are determined separately for two different types of pumice granulate. This document refers to the manufacture of ROTOCELL and ROTOCELL plus pumice granulate by ROTEC GmbH & Co. KG. Production data for 2011 as a reference year was collated in both ROTEC GmbH & Co. KG factories. The Life Cycle Assessment, which is based on plausible, transparent and comprehensible basic data, therefore fully represents the ROTEC GmbH & Co. KG products referred to. The owner of the Declaration is responsible for the information and verification on which it is based.

**Verification**

The CEN EN 15804 standard serves as the core PCR.

Verification of the EPD by an independent third party in accordance with ISO 14025

☐ internal ☒ external

Prof. Dr-Ing. Horst J. Bossenmayer
(President of Institute Construction and Environment e.V.)

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of the Expert Committee)

Dr.-Ing. Wolfram Trinius
(Independent auditor appointed by the Expert Committee)

# 2 ROTOCELL & ROTOCELL plus

## 2.1 Product description

The product involves mineral, siliceous, glass-like, lightweight aggregates which are manufactured from natural pumice in a mechanical preparation process complying with the requirements of the DIN V 18151-100. The following sieve fractions are manufactured:

0.04 to 0.09 mm, 0.09 to 0.3 mm, 0.25 to 0.5 mm, 0.5 to 1.0 mm, 1.0 to 2.0 mm and 2.0 to 4.0 mm

## 2.2 Application

ROTOCELL and ROTOCELL plus are used for manufacturing premixed mortar (interior and exterior plaster, finishing coats, construction and tile adhesive, lightweight fillers etc.) and for chemical construction products (levelling compounds, paste-like ready-mixed plaster, coatings etc.).

The only differences between the two products concern their respective water absorption capacity. ROTOCELL plus should be given preference in applications in which low water absorption is indispensable.

## 2.3 Technical data

The technical data for ROTOCELL plus is the same as for ROTOCELL in its non-hydrophobic variant.

| ROTOCELL® product specifications | | | | | | |
|---|---|---|---|---|---|---|
| Grain size in mm | 0.04-0.09 | 0.09-0.3 | 0.25-0.5 | 0.5-1.0 | 1.0-2.0 | 2.0-4.0 |
| Bulk weight in kg/m³ | 450 ± 15% | 360 ± 15% | 320 ± 15% | 310 ±- 15% | 300 ± 15% | 290 ± 15% |
| Thermal conductivity in W/mK | * | * | * | 0.08 | 0.08 | 0.08 |
| Average grain strength C N/mm² | * | 22** | 18** | 18** | 18** | 12** |
| Melting point in °C | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| pH value | 7-8 | 7-8 | 7-8 | 7-8 | 7-8 | 7-8 |
| Colour | beige | beige | beige | beige | beige | beige |
| Average grain gross density in kg/m³ | * | 700 | 700 | 600 | 550 | 500 |
| Mohs hardness | 3 | 3 | 3 | 3 | 3 | 3 |
| Oversized and undersized grains | ≤10% / ≤15% | ≤10% / ≤15% | ≤10% / ≤15% | ≤10% / ≤15% | ≤10% / ≤15% | ≤10% / ≤15% |

* on request | ** determined on the basis of DIN V 18004 | Additional grain sizes to 16 mm on request

## 2.4 Placing on the market / Application rules

The product involves lightweight aggregates in accordance with DIN EN 13055-1: 2002 which can be used for concrete and mortar. The grain sizes are subject to in-plant production control based on this standard. Rotec GmbH is certified in accordance with DIN EN ISO 9001. Application is regulated in accordance with the respective standards for the individual product classes, i.e. DIN EN 998-2 for masonry mortar or DIN EN 998-1 for plaster mortar.

## 2.5 Delivery status

Dry fine grains usually sold loose by weight

## 2.6 Base materials / Auxiliaries

On account of its volcanic development, pumice is already foamed. The chemical composition for both types complies with the following list:

| Chemical analysis ROTOCELL | | |
|---|---|---|
| Silicic acid | $SiO_2$ | ≈ 56.0% |
| Clay | $Al_2O_3$ | ≈22.0% |
| Alkalis | $K_2ONa_2O$ | ≈5%/7% |
| Iron oxide | $Fe_2O_3$ | ≈3.0% |
| Calcium oxide | CaO | ≈2.0% |
| Magnesium oxide | MgO | ≈0.5% |
| Titanium dioxide | $TiO_2$ | ≈0.5% |
| Annealing loss | | ≈3.5% |

Apart from its mineral main components, ROTOCELL plus also contains 0.75% dimethylsiloxane as a hydrophobing agent. No other ingredients are contained.

## 2.7 Manufacture

A large proportion of pumice deposits from which crude pumice is extracted is owned by shareholders in Rotec. The deposits can be found within a radius of 20 km of the washing plant in Urmitz. Crude pumice is extracted in open-cast mining and transported to Urmitz by tipper truck in 24-tonne loads. The pumice is washed in the washing plant, i.e. sludged in a multi-stage process during which heavy and light particles are separated. The water used is exclusively surface water collected in the gravel pits surrounding the plant in Urmitz. The water is reused in a closed circuit. Approx. 14 cubic metres of recycled water is incurred by one tonne of washed pumice. Losses incurred demand that a small volume of fresh water (approx. 5%, complying with 0.6 cubic metres of water per tonne washed pumice) is added and which does not require any treatment. No waste is incurred during the manufacturing process as both the light and heavy particles are used as raw materials for various areas of application. The so-called washed pumice is then transported by tipper truck in 24-tonne loads to the plant in Neuwied which is approx. 12 km away. In Neuwied, the washed pumice is dried in a gas-powered batch dryer. One tonne of wet washed pumice provides 0.593 tonnes of dried pumice which is broken, sieved and separated before being broken down into the individual grain fractions. The last stage of ROTOCELL grain production involves interim storage in silos.

The manufacturing process for ROTOCELL plus is identical to that of ROTOCELL, although it does involve an additional process step – hydrophobation, which involves mixing dimethylsiloxane (< 1%) and water with the individual ROTOCELL grains. The mixture is homogenised in a high-performance mixer and then dried again. Interim storage is also in silos.

## 2.8 Health and environment factors during manufacturing

ROTOCELL and ROTOCELL plus involve lightweight aggregates which are exclusively manufactured by means of a mechanical process using the natural raw material pumice. Pumice does not contain any quartz or other components representing a hazard to health. For this reason, no industrial protection measures are required which extend beyond the national regulations or regulations specified by the professional liability association. Preparation is exclusively in closed areas to minimise noise pollution. No waste air or waste water is incurred during production; water from the washing plant is directed into a closed circuit.

## 2.9 Product processing/installation

Machinery (crushers, sifting machines, separators etc.) are used in accordance with the statutory specifications and the regulations of the professional liability association. Processing is within a closed system; any dust incurred is collected in electric filters.

## 2.10 Packaging

90% of ROTOCELL and ROTOCELL plus is sold as loose goods and filled directly from the storage silos into silo trucks. The remaining volumes are packed into 1 m³, 2 m³ and 2.4 m³ BigBags and PE sacks for sale.

## 2.11 Condition of use

ROTOCELL and ROTOCELL plus are used as lightweight aggregates in this form of delivery. On account of their composition, they do not display any particular features which need to be observed during the usage phase.

## 2.12 Health and environment factors during use

As they involve an intermediate product, the relationships between the product, environment and health evolve from the features of the end product to which ROTOCELL and ROTOCELL plus are processed. The corresponding manufacturer's safety data sheets shall apply.

## 2.13 Reference Service Life

The reference service life is not declared for these two types of pumice granulate as they involve intermediate products. The service life in turn depends on the end products to which ROTOCELL and ROTOCELL plus are processed. As the product involves a purely mineral lightweight aggregate which can not disintegrate, the other ingredients usually determine the service life of the end products.

## 2.14 Extraordinary effects

**Fire**

ROTOCELL and ROTOCELL plus are classified as A1 building material class to DIN 4102; they are incombustible, do not melt until approx. 1000 °C and do not develop any toxic combustion gases.

**Water**

As loose bulk goods, ROTOCELL and ROTOCELL plus float; when saturated with water, they sink. When processed, performance depends on the features of the end product.

**Mechanical destruction**

When subject to mechanical load, the grains are crushed. When processed, performance depends on the features of the end product.

## 2.15 Re-use phase

ROTOCELL and ROTOCELL plus as loose bulk goods can be re-used directly. When processed, recyclability depends on the features of the end product.

## 2.16 Disposal

ROTOCELL and ROTOCELL plus as loose bulk goods can be easily disposed of in a building debris landfill (EAK 170107). When processed, disposal is dependent on the features of the end product and the respective disposal key indicated in the safety data sheet (e.g. EAK 170101 for concrete).

## 2.17 Further information

Further information on the technical features, forms of delivery etc. is provided on the Rotec GmbH & Co. KG Web site: www.rotec-nature.de

# 3 LCA: Calculation rules

## 3.1 Declared unit

The Declaration refers to the manufacture of ROTOCELL and ROTOCELL plus, both produced by ROTEC GmbH & Co. KG. The results are always depicted for 1 tonne of the respective lightweight aggregate.

## 3.2 System limit

Type of EPD: cradle to factory gate

The following processes were included in the **A1-A3** product stages of ROTOCELL manufacturing:

- Provision processes concerning consumables and energy
- Transporting resources and consumables to the factory
- Manufacturing process for ROTOCELL in the factory including energetic expenses, production of consumables, disposal of residual materials incurred.
- In the case of ROTOCELL plus, manufacturing of ROTOCELL is followed by the hydrophobation step including production and application of hydrophobation.

> 90% of the pumice grains are distributed as loose goods which is why pro rata packaging has been ignored.

## 3.3 Estimates and assumptions

ROTOCELL plus is hydropbobised with the aid of dimethylsiloxane whose production is estimated as that of siloxane on account of its similarity to the chemical group.

## 3.4 Cut-off criteria

All operating data, i.e. all of the starting materials used, thermal energy, internal fuel consumption and electricity consumption, all direct production waste as well as all emission measurements available were taken into consideration in the analysis. Assumptions were made as regards the transport expenses associated with all input and output data taken into consideration. Accordingly, material and energy flows with a share of less than 1 per cent were also considered (with the exception of packaging). > 90% of the pumice grains are distributed as loose goods which is why pro rata packaging has been ignored. It can be assumed that the total of all neglected processes does not exceed 5% in the effective categories. The machinery, plants and infrastructure required in the manufacturing process are ignored.

## 3.5 Background data

"GaBi 4" - the software system for comprehensive analysis developed by PE INTERNATIONAL AG - was used for modelling ROTOCELL production. The consistent data items contained in the GaBi data base are documented in the online GaBi documentation. The basic data in the GaBi data base was applied for energy, transport and consumables. The Life Cycle Assessment was drawn up for Germany as a reference area. This means that apart from the production processes under these marginal conditions, the pre-stages also of relevance for Germany such as provision of electricity or energy carriers were used. The German Power Mix for 2008 as the reference year is used.

### 3.6 Data quality

All of the background data records of relevance for manufacturing were taken from the GaBi 4 data base or made available by ROTEC GmbH & Co. KG. The background data used was last revised less than 10 years ago. Production data involves current industrial data from ROTEC GmbH & Co. KG dated 2011. Data was recorded for the pumice washing plant as well as additional data for refinement in the Neuwied plant. Pumice mining was depicted for Germany using average data available from the GaBi data base (2006) in co-ordination with ROTEC GmbH.

### 3.7 Period under review

The data for this Life Cycle Assessment is based on data records for ROTOCELL production from 2011 by ROTEC GmbH & Co. KG. The volumes of raw materials, energy, auxiliaries and consumables are considered as average values over 12 months in the two plants (Urmitz and Neuwied).

### 3.8 Allocation

No allocations were made as exclusively ROTOCELL is manufactured in the production processes. All of the plant data refers exclusively to the declared product. Data for the additional hydrophobation process step is exclusively allocated to the ROTOCELL plus product. No co-products arise in either of the plants. No allocations were performed for this within the framework of the Life Cycle Assessment. Open- or closed-loop recycling is not performed in the process steps for manufacturing the product under review.

### 3.9 Comparability

As a general rule, a comparison or assessment of EPD data is only possible when all of the comparable data records have been drawn up in accordance with EN 15804 and the building context and/or product-specific performance features taken into consideration.

## 4 LCA: Scenarios and other technical information

Both pumice grain types are intermediate products. The development of specific scenarios in the context of a building assessment can not be carried out at this level but is dependent on the end product.

Within the Declaration for ROTOCELL and ROTOCELL plus, modules A4 to D are not declared nor is there any technical information available.

## 5 LCA: Results

The environmental impacts of 1 tonne of ROTOCELL pumice grain manufactured by ROTEC GmbH & Co. KG are depicted below. The modules marked "x" in the overview in accordance with EN 15804 are addressed here; the modules marked "MND" (module not declared) are not a component of the review.

The following tables depict the results of the indicators concerning the estimated impact, use of resources as well as waste and other output flows in relation to 1 tonne of ROTOCELL and ROTOCELL plus. The estimated impact results only represent relative statements. They do not make any claims as regards the end points of impact categories, exceeding threshold values, safety margins or risks.

**INDICATION OF SYSTEM LIMITS (X = INCLUDED IN LIFE CYCLE ASSESSMENT; MND = MODULE NOT DECLARED)**

| Production stage | | | Building construction stage | | Usage stage | | | | | | | Disposal stage | | | | Credits and burdens outside the system limit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Raw material supplies | Transport | Manufacture | Transport to site | Installation in the building | Use / Application | Maintenance | Repairs | Substitution[)] | Renewal[)] | Energy used for operating the building | Water used for operating the building | Dismantling / Demolition | Transport | Waste treatment | Landfilling | Re-use, recovery or 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 LIFE CYCLE ASSESSMENT ENVIRONMENTAL IMPACTS: 1 tonne ROTOCELL pumice**

| | | ROTOCELL | ROTOCELL plus |
|---|---|---|---|
| **Parameter** | **Unit** | **A1-A3** | **A1-A3** |
| Global warming potential | [kg $CO_2$ equiv.] | 48.9 | 143.7 |
| Depletion potential of the stratospheric ozone layer | [kg CFC11 equiv.] | 5.78E-06 | 2.06E-05 |
| Acidification potential of soil and water | [kg $SO_2$ equiv.] | 0.076 | 0.310 |
| Eutrification potential | [kg $PO_4^{3-}$ equiv.] | 0.009 | 0.030 |
| Formation potential for tropospheric ozone | [kg ethene equiv.] | 0.008 | 0.025 |
| Potential for abiotic depletion of non-fossil resources | [kg Sb equiv.] | 1.81E-06 | 2.04E-03 |
| Potential for abiotic depletion of fossil fuels | [MJ] | 582.0 | 1814.6 |

| RESULTS OF THE LIFE CYCLE ASSESSMENT USE OF RESOURCES: 1 tonne ROTOCELL pumice | | | |
|---|---|---|---|
| | | ROTOCELL | ROTOCELL plus |
| **Parameter** | **Unit** | **A1-A3** | **A1-A3** |
| Regenerative primary energy as an energy carrier | [MJ] | 74.6 | 457.3 |
| Regenerative primary energy for material use | [MJ] | 0.00E+00 | 0.00E+00 |
| Total regenerative primary energy | [MJ] | 74.6 | 457.3 |
| Non-regenerative primary energy as an energy carrier | [MJ] | 786.00 | 2542.84 |
| Non-regenerative primary energy for material use | [MJ] | 0.00E+00 | 0.00E+00 |
| Total non-regenerative primary energy | [MJ] | 786.00 | 2542.84 |
| Use of secondary materials | [kg] | 0.00E+00 | 0.00E+00 |
| Regenerative secondary fuels | [MJ] | 0.01 | 0.02 |
| Non-regenerative secondary fuels | [MJ] | 0.02 | 0.08 |
| Use of fresh water resources | [m³] | 1.50 | 2.74 |

| RESULTS OF THE LIFE CYCLE ASSESSMENT OUTPUT FLOWS AND WASTE CATEGORIES: 1 tonne ROTOCELL pumice | | | |
|---|---|---|---|
| | | ROTOCELL | ROTOCELL plus |
| **Parameter** | **Unit** | **A1-A3** | **A1-A3** |
| Hazardous waste for landfilling | [kg] | 0.0003 | 0.0376 |
| Disposed of, non-hazardous waste | [kg] | 199.8 | 707.5 |
| Disposed of, radioactive waste | [kg] | 0.073 | 0.259 |
| Components for re-use | [kg] | - | - |
| Substances for recycling | [kg] | - | - |
| Substances for energy recovery | [kg] | - | - |
| Exported energy per type | [MJ] | - | - |
| Exported energy per type | [MJ] | - | - |

## 6 LCA: Interpretation

### ROTOCELL

Within the framework of a dominance analysis, it is apparent that the environmental impacts of ROTOCELL manufacture are mainly caused by the "drying" module. This is attributable to the significant use of electricity in this module and the corresponding emissions in the upstream chains of electricity supply.

When reviewing the use of abiotic resources of elements, lead, zinc and copper ore requirements are particularly represented in the upstream chains associated with the provision of electricity.

The use of fossil abiotic resources is determined by approx. 61% by the use of electricity in the drying process.

The Global Warming Potential (GWP) during manufacture of one tonne of ROTOCELL is 95% dominated by carbon dioxide emissions. 75% of these emissions originate from the drying process to which the upstream chains associated with the provision of electricity make a significant contribution to the Global Warming Potential.

The Acidification Potential (AP) during manufacture of one tonne of ROTOCELL is 60% dominated by sulphur dioxide emissions and 40% is attributable to nitric oxide. Both the sulphur dioxide emissions and nitric oxides primarily originate in the upstream chains associated with the provision of electricity.

When reviewing the Eutrification Potential (EP) which is 87% determined by nitric oxides, the dominance of electricity provision is also apparent. Accordingly, 50% of the total nitric oxide volume arises solely as a result of electricity requirements in the "drying" module.

The Summer Smog Potential (POCP) is accounted for by approx. 23% sulphur dioxide emissions, 38% NMVOC and around 21% nitric oxides which, in turn, primarily arise during the upstream chains of electricity provision but also during combustion of diesel in construction machinery.

When reviewing the use of non-regenerative and regenerative energy, the dominance of the drying process step is also obvious. This is attributable to the energy carriers for producing electricity (German Power Mix).

Around 1.5 cubic metres of water are required for the production of one tonne of ROTOCELL via modules A1-A3, including the upstream chains. The greatest share is required by the washing plant.

### ROTOCELL plus

Within the framework of a dominance analysis, it is apparent that the environmental impacts of ROTOCELL plus manufacture are dominated by the "hydrophobation" module. Apart from hydrophobation as an additional material component, this is attributable to the significant use of electricity in this module and the corresponding emissions in the upstream chains of electricity supply.

The ADPf is largely determined by the hydrophobation process step, to which the upstream chains associated with siloxane production as well as the provision of electricity (for mixing and drying) are equally attributable. The drying module accounts for 23% of the fossil abiotic use of resources.

The Global Warming Potential (GWP) during manufacture of one tonne of ROTOCELL plus is fully dominated by carbon dioxide emissions. Around two-thirds of these emissions originate from the hydrophobation process to which the upstream chains associated with the provision of electricity make a significant contribution to the Global Warming Potential.

The Acidification Potential (AP) during manufacture of one tonne of ROTOCELL plus is 67% dominated by sulphur dioxide emissions while 32% is attributable to nitric oxide. Both the sulphur dioxide emissions and nitric oxides primarily originate in the upstream chains associated with the production of siloxane as well as the provision of electricity.

When reviewing the Eutrification Potential (EP) which is 86% determined by nitric oxides, the dominance of siloxane and electricity provision is also apparent. Accordingly, siloxane production alone is responsible for 44% of all nitice oxides.

The Summer Smog Potential (POCP) is accounted for by approx. 33% sulphur dioxide emissions, 31% NMVOC and around 22% nitric oxides which, in turn, primarily arise during the upstream chains associated with the provision of siloxane and electricity.

When reviewing the use of non-regenerative and regenerative energy, the dominance of the hydrophobation process step is also obvious. 750 MJ of the PENRT can be attributed to the upstream chains associated with siloxane production. The majority share results however from the requirements of energy carriers for generating electricity during the hydrophobation and drying processes (Power Mix).

Around 2.7 cubic metres of water are required for the production of one tonne of ROTOCELL plus via modules A1-A3, including the upstream chains. The majority share is required in the washing plant as well as during the hydrophobation process when the water is re-applied to the product.

**Both ROTOCELL pumices**

Secondary raw materials are not used in the manufacture of ROTOCELL.

A low share of secondary raw materials originates from the upstream chains associated with the provision of electricity.

An analysis of the waste volumes incurred is depicted separately for the three main fractions: (1) disposed of, non-hazardous waste (including mining waste, excavation waste, ore treatment residue, municipal solid waste including domestic and commercial waste contained therein), (2) hazardous waste for landfilling and (3) disposed of radioactive waste. The largest share is represented by non-hazardous waste. Excavation waste is primarily incurred in the upstream chain associated with the generation of electricity when extracting energy carriers. Radioactive waste is exclusively incurred by generating electricity in nuclear power plants. Hazardous waste is also attributable to upstream energy generation processes.

## 7 Requisite evidence

**Leaching performance**

| | O | A | O | A |
|---|---|---|---|---|
| [mg/kg] TS | ROTOCELL 1-2 mm | | ROTOCELL plus 0.5-1 mm | |
| Mg | 0.29 | 0.17 | 1.12 | <0.1 |
| Ca | 1.38 | 1.58 | 6.13 | <0.5 |
| Na | 98.1 | 113 | 94.9 | 152 |
| K | 24.2 | 17.2 | 17.8 | 18.5 |
| Cl | 31.8 | 42.4 | 44.7 | 59.0 |
| $SO_4$ | 61.9 | 72.2 | 58.3 | 87.1 |

O – Original sample    A – Fine analysis

Measuring agency: KI Keramik Institut GmbH

Measuring protocols: 04.07.2011

Measurement results: Eluate from 6 samples of pumice granulate (KI 2011)

Test process: DIN EN ISO 11885 (for Mg, Ca, Na, K), DIN 38405 D1 (Cl), DIN 38405 D5 (SO4)

**Radioactivity**

Measuring agency: Institut für Biophysik, Prof. Dr. Gerd Keller, University of Saarland

Measuring protocol: 21.07.2006

Measurement results: Radioactivity in pumice granulate

| Nuclides | $^{226}Ra$ | $^{232}Th$ | $^{40}K$ |
|---|---|---|---|
| Activity [Bq/kg] | 239 | 332 | 1320 |

The concentration values measured in the sample are of the same level as those for conventional construction materials. From a radiological perspective, risks can be excluded when this pumice granulate is used as designated (Keller 2006).

## 8 Literary references


**Institute Construction and Environment 2011**

Institute Construction and Environment e.V., Königswinter (pub.): Drawing up Environmental Product Declarations (EPP); General principles for the EPD range of Institute Construction and Environment e.V. (IBU), 2011-06, www.bau-umwelt.de

**PCR 2011, Part A**

Institute Construction and Environment e.V., Königswinter (pub.): Product Category Rules for construction products from the range of Environmental Product Declarations from Institute Construction and Environment (IBU) Part A: Calculation rules for the Life Cycle Assessment and requirements on the background report. 2011-07, www.bau-umwelt.de

**PCR 2011, Part B**

Institute Construction and Environment e.V., Königswinter (pub.): Product Category Rules for construction products from the range of Environmental Product Declarations from Institute Construction and Environment (IBU) Part B: Requirements on the EPD for lightweight aggregates / loose granulate. 2011-06, www.bau-umwelt.de

**ISO 14025**

DIN EN ISO 14025:2009-11, Environmental labels and declarations — Type III Environmental Declarations — Principles and procedures

**DIN EN 15804**

DIN EN 15804:2011-05, Sustainability of buildings – Environmental Declarations for products – Basic rules for the construction products product category; German version EN 15804:2011

**2000/532/EG**

2000/532/EG: Decision by the Commission dated 3 May 2000 replacing the 94/3/EG decision on a waste directory as per Article 1 a) of Council Directive 75/442/EWG on waste and Council decision 94/904/EG on a directory of hazardous waste as per Article 1, section 4 of the 91/689/EWG Directive on hazardous waste

**DIN 4102**

DIN 4102-1:1998-05, Fire performance of building materials and components - Part 1: Building Materials, Terms, Requirements and Tests

**DIN EN 13055-1**

DIN EN 13055-1: 2002, Lightweight aggregates - Part 1: Lightweight aggregates for concrete, mortar and grout; German version EN 13055-1:2002

**DIN EN 998-1**

DIN EN 998-1:2010-12, Title (German): Specifications for mortar in masonry - Part 1: Plastering mortar; German version EN 998-1:2010

**DIN EN 998-2**

DIN EN 998-2:2010-12, Title (German): Specifications for mortar in masonry - Part 2: Masonry mortar; German version EN 998-2:2010

**DIN V 18151-100**

DIN V 18151-100:2005-10, Hollow blocks made of lightweight concrete - Part 100: Hollow blocks with special properties

**DIN EN ISO 11885**

DIN EN ISO 11885:2009, Water quality - Determining selected elements via inductively coupled plasma atomic emission spectrometry (ICP-OES) (ISO 11885:2007); German version EN ISO 11885:2009

**DIN 38405**

DIN 38405:1985-12, German uniform procedure for examining water, waste water and sludge; Anions (Group D)

**DIN EN ISO 9001**

DIN EN ISO 9001:2008, Quality management systems - Requirements (ISO 9001:2008); trilingual version EN ISO 9001:2008

**GaBi software**

GaBi 4: Software and data base for comprehensive analysis. LBP, University of Stuttgart and PE International, 2011

**GaBi documentation**

GaBi 4: Documentation of GaBi 4 data records in the data base for comprehensive analysis LBP, University of Stuttgart and PE International, 2011. http://documentation.gabi-software.com/

**Keller 2006**

Professor Dr. Gert Keller, Institut für Biophysik, University of Saarland, Measurements of activity concentrations of natural radionuclides in pumice granulate, Homburg, 2006

**KI 2011**

Keramik Institut GmbH, test protocol KI LS 587-11/Pr.01-06 on determining water-soluble substances in Rotocell on behalf of Rotec GmbH, Meißen, 2011

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**Marius Schütz, Theley, 3 April 2012**

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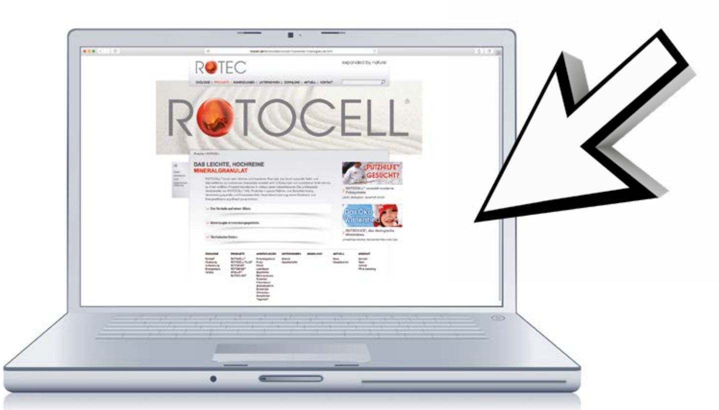

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