# ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

| | |
|---|---|
| Owner of the Declaration | Rudolf Hensel GmbH |
| Publisher | Institut Bauen und Umwelt e.V. (IBU) |
| Programme holder | Institut Bauen und Umwelt e.V. (IBU) |
| Declaration number | EPD-RHG-20240230-IBA6-EN |
| Issue date | 28.05.2026 |
| Valid to | 13.02.2030 |

## HENSOTHERM® 920 KS / 980 KS

## Rudolf Hensel GmbH

Institut Bauen und Umwelt e.V.

**www.ibu-epd.com | https://epd-online.com**

ECO PLATFORM EPD VERIFIED

FIRE PROTECTION SYSTEMS

# 1. General Information

## Rudolf Hensel GmbH

**Programme holder**

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

**Declaration number**

EPD-RHG-20240230-IBA6-EN

**This declaration is based on the product category rules:**

Coatings with organic binders, 01.08.2021
(PCR checked and approved by the SVR)

**Issue date**

28.05.2026

**Valid to**

13.02.2030

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

Dr. Martina Bender
(Managing Director Institut Bauen und Umwelt e.V.)

## HENSOTHERM® 920 KS / 980 KS

**Owner of the declaration**

Rudolf Hensel GmbH
Lauenburger Landstraße 11
21039 Börnsen
Germany

**Declared product / declared unit**

The declared product is HENSOTHERM® 920 KS / 980 KS. The declared unit refers to one kilogramme of product. Packaging is included in the calculation. The declared unit is given in [kg].

**Scope:**

This document refers to HENSOTHERM® 920 KS / 980 KS. Specific data from the Börnsen manufacturing plant of Rudolf Hensel GmbH was collected for the preparation of the life cycle assessment (LCA). Data from the year 2022 is used as a basis, which corresponds to the annual average.

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 evidence.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard is abbreviated as *EN 15804*.

**Verification**

| |
|---|
| The standard EN 15804 serves as the core PCR |
| Independent verification of the declaration and data according to ISO 14025:2011 |
| ☐ internal ☒ external |

Dr.-Ing. Wolfram Trinius,
(Independent verifier)

# 2. Product

## 2.1 Product description/Product definition

HENSOTHERM® 920 KS / 980 KS are 100% solvent-free, two-component (2K) fire protection coatings for the fire protection improvement of steel profiles and steel structures in interior and exterior areas. These are in-house manufactured reactive epoxy coatings with mineral fillers, pigments, and additives. The coatings are classified as low-emission and contain no halogens, alkylphenols, or benzyl alcohols.

The fire protection coatings are part of the Green Product line at Rudolf Hensel GmbH.

**Products according to CPR with ETA:**
Regulation *(EU) No. 305/2011 (CPR)* applies to the placing on the market of the HENSOTHERM® 920 KS product in the *EU/EFTA* (with the exception of Switzerland). The product requires a Declaration of Performance in accordance with *ETA No. 21/0475* and *aBG No. Z-19.51-2629* for HENSOTHERM® 920 KS and the corresponding CE marking.

The respective national regulations apply for use.

The following authorisations apply for placing the HENSOTHERM® 920 KS product on the market outside the EU: British Standard *BS 476, Parts 20 and 21, No. CF 5994*, *VKF technical information No. 32192* in accordance with Swiss fire protection regulations, as well as *Australian Standard 4100:1998* and the corresponding CE marking.
The respective national regulations apply at the place of use; in Germany, for example, the building regulations of the federal states, and the technical specifications based on these regulations.

## 2.2 Application

HENSOTHERM® 920 KS is used to improve the fire performance of open profiles such as I-beams, H-beams, compression members, columns, and tension profiles of various sizes in structural steel and closed profiles such as rectangular/square and round hollow section columns and compression members.

In general, the complete coating system consists of a suitable anti-corrosion primer, the fire protection coating and, if required, a suitable top coat. Primers and top coats are not part of this EPD.

European Technical Assessment according to *EAD 350402-00-1106*: HENSOTHERM® 920 KS is rated as a reactive coating for the fire protection of steel elements.

HENSOTHERM® 920 KS is classified in accordance with *EN 13501-1* as Euroclass **E**.

HENSOTHERM® 920 KS is classified in accordance with *EN 13501-2* for a fire-resistance period of up to 150 minutes.

HENSOTHERM® 920 KS is tested in accordance with *EN 13381-8* for a fire-resistance period of up to 150 minutes.

HENSOTHERM® 920 KS is approved in accordance with *BS476* for a fire-resistance period of up to 180 minutes.

HENSOTHERM® 920 KS is tested from R30 to R60 in accordance with *VKF Technical Information No. 32192.*

HENSOTHERM® 980 KS is intended for the fire protection upgrading of interior and exterior areas of railway vehicles.

HENSOTHERM® 980 KS is classified in accordance with *DIN EN 45545-2* and fulfils the requirements of class HL 3 for R1 and R7.

## 2.3 Technical data

HENSOTHERM® 920 / 980 KS do not contain any hazardous substances above the limit values according to *REACH Regulation, Annex XVII*.

**Structural data**

| Name | Value | Unit |
|---|---|---|
| Colour | Telegrey 1, RAL 7045 | - |
| Density (liquid, 25 °C) | 1150-1350 | kg/m³ |
| Storage temperature | 5 - 30 | °C |
| Shelf life (unopened, 20 °C) | 15 | months |
| Pot/processing times (30°C bis 35°C) | 45 | minutes |
| Pot/processing times (40°C bis 45°C) | 30 | minutes |
| Fire behaviour acc. to EN 13501-1 | Construction material class E | - |
| Fire resistance acc. to EN 13381-8 \| EN 13501-2 | R15 - R150 | - |
| Durability acc. to EAD 350454-00-1106 | X, Y, Z1 und Z2 | - |
| Corrosivity category acc. to DIN EN ISO 12944 (System) | C5, very high | - |

HENSOTHERM® 920 KS / 980 KS are emission-rated, 2-component fire protection coatings. Sampling, testing and evaluation were carried out in accordance with *AgBB* and *Leed* in the current version.

**Products according to CPR with ETA:**
Performance values of the HENSOTHERM® 920 KS product correspond to the Declaration of Performance with regard to its essential characteristics according to *ETA No. 21/0475* and *aBG No. Z-19.51-2629* for HENSOTHERM® 920 KS and the corresponding CE marking.
The respective national regulations apply for use.

Performance values of the HENSOTHERM® 920 KS product outside the EU refer to its essential characteristics according to *British Standard BS 476, Parts 20 and 21, No. CF 5994*, *VKF technical information No. 32192* according to the Swiss fire protection regulations as well as *Australian Standard 4100:1998* and the corresponding CE marking.
The respective national regulations apply at the place of use; in Germany, for example, the building regulations of the federal states, and the technical specifications based on these regulations.

## 2.4 Delivery status

HENSOTHERM® 920 KS / 980 KS are liquid, 2-component coating materials and are sold in metal buckets of different sizes. HENSOTHERM® 920 KS / 980 KS base is available in containers from 2.5 kg to 200 kg; HENSOTHERM® 920 KS / 980 KS hardener is available in containers from 1 kg to 200 kg.

## 2.5 Base materials/auxiliary materials

| Name | Value | Unit |
|---|---|---|
| Ammonium polyphosphate | 15 - 30 | % |
| Epoxy resin | 15 - 30 | % |
| Reactive polyamides | 5 - 20 | % |
| Flame retardants | 5 - 15 | % |
| Melamine | 5 - 15 | % |
| Titanium dioxide | 2 - 10 | % |
| Alumina | 1 - 8 | % |
| Acrylic acid ester | 1 - 5 | % |
| Carbon fibres | 1 - 5 | % |
| Reactive polyamides | 1 - 5 | % |

The product contains substances on the *ECHA* list of substances of very high concern (SVHC) for authorisation (14 March 2024) above 0.1 mass %: yes.

Melamine (CAS: 108--78--1)

Contains: 5- 15% [m/m]

H351 may cause cancer.
H361f may impair fertility.

### 2.6 Manufacture

HENSOTHERM® 920 KS / 980 KS is manufactured in a fully-automatically controlled dispersion system. The dosing of liquid raw materials is largely automatic, powders are dosed manually. The preliminary products required for production are made available after an incoming goods inspection.
After production of the batches, an in-house quality control is carried out. This includes product-related and fire protection-related quality features.
In addition to the factory inspection, official external monitoring is carried out at regular intervals.

### 2.7 Environment and health during manufacturing

The preliminary products are stored in such a way that they cannot, according to human judgement, enter the environment.

In the case of raw materials that are automatically dosed, direct contact between workers and the preliminary products is avoided. Direct contact with the raw material is minimised when dosing the powdered raw materials manually. In addition to sufficiently dimensioned extraction systems, workers are provided with protective clothing and dust masks. Suitable personal protective equipment is also provided.

The production process is optimised in such a way that the system components are mainly cleaned in situ. Any cleaning agent incurred is collected, distilled and reused.

All types of waste are separated, stored, and returned to the recycling circuit.

### 2.8 Product processing/Installation

Application should primarily be carried out by spraying. Application by brush is possible for very small areas.

Details on substrate pre-treatment, application requirements, and drying behaviour can be found in the relevant technical data sheet (see www.rudolf-hensel.de).

### 2.9 Packaging

The coatings are filled into metal cans, which are recycled by the customer through a packaging return system.
The paper bags are packed on pallets for shipping and protected with a shrink film made of low-density polyethylene (LDPE).

### 2.10 Condition of use

Both coatings are epoxy-based, intumescent, two-component fire protection coatings for the protection of steel components. After application of the coatings, the film is formed by chemical cross-linking of the epoxy groups contained in the formulation. The cross-linked polymer film including the non-volatile ingredients remains on the coated component. Powdery solids such as melamine are firmly bound into the polymer matrix.

### 2.11 Environment and health during use

HENSOTHERM® 920 KS / 980 KS are coatings with extremely low emissions and are considered to be harmless to human health.
Emission tests – carried out in independent laboratories – confirmed that the fire protection coatings fulfil the requirements of various national and international emission standards, with classification in the lowest emission class (see section 7).

The coatings contain no halogens, alkylphenols, or benzyl alcohols.

### 2.12 Reference service life

The provisions made in *ETA No. 21/0475* are based on an assumed working life of the applied coating for the intended use of at least 10 years for the use categories Z2, Z1, X and Y, provided that it is adequately used and maintained in accordance with the manufacturer's instructions.

The *EAD 350402-00-1106* allows the assumption of a service life of 25 years if the *ETA* applicant can provide sufficient additional documented evidence for the technical inspection. Rudolf Hensel GmbH has provided additional information for type Z2. The data presented confirms the use of HENSOTHERM® 920 KS for a service life of 25 years for utilisation category type Z2. Accordingly, a service life of 25 years is assumed for utilisation category type Z2.
HENSOTHERM® 920 KS has been classified according to *DIN EN ISO 12944-6 (2018)* in the system with primer and top coat for corrosivity category C5, very high protection duration. This classification certifies a corrosion protection of > 25 years.

The indications given on the service life cannot be interpreted as a guarantee given by the producer or the Technical Assessment Body, issued by the *ETA* on the basis of *EAD 350402-00-1106*, but are to be regarded only as a means for choosing the right product in relation to the anticipated economically reasonable service life.

### 2.13 Extraordinary effects

**Fire**

Intumescent fire protection coatings are reactive systems, which under the influence of temperature – due to a strong increase in volume (blowing agent melamine, or its salts – decomposition to NH3, N2, H2O and CO2) – form a carbon-rich insulation layer. Due to its very low thermal conductivity, the insulation layer protects the substrate against a material-destroying temperature increase. Further exposure to temperature finally produces a stable inorganic insulation layer, mainly consisting of titanium pyrophosphate. The effect of the fire protection coating is therefore not reversible.

**Fire protection**

| Name | Value |
|---|---|
| Building material class acc. to EN 13501-1 | E |
| Fire resistance \| EN 13381-8 acc. to EN 13501-2 | R15 - R150 |

**Water**

HENSOTHERM® 920 KS / 980 KS are fire protection coatings that can be used in accordance with *EAD 350402-00-1106*

utilisation categories X/Y/Z1/Z2 in interior and weathered exterior areas.

Short-term immersion (e.g. flooding) has no negative impacts on the coating.

**Mechanical destruction**
Small containers of fire protection coatings are available for repairing surface damage and surface impairments by brush.

There are no known consequences for the environment due to unforeseen mechanical destruction.

### 2.14 Re-use phase

Due to the organic content, HENSOTHERM® 920 KS / 980 KS have a substance-inherent energy content that can be recovered in incineration plants. Taking into account the carbon content of the coating, the steel coated with the aforementioned fire protection coatings can be fed directly into the steel recycling process.

In the event that the fire protection coating is to be deposited separately, landfillability is guaranteed.

### 2.15 Disposal

The following waste code numbers must be taken into account:

a) coated steel
*AVV No. 170405* (recommended): Construction and demolition waste – Iron and steel

b) Solid product residues:

*AVV No. 080118* (recommended): Waste from paint or varnish removal other than that mentioned in 080117

c) Liquid product residues:

*AVV No. 080111* (recommended): Paint and varnish waste containing organic solvents or other hazardous substances

*AVV No. 150110* (recommended): Packaging that contains residues of hazardous substances or is contaminated by hazardous substances

### 2.16 Further information

Further product information is available at www.rudolf-hensel.de.

## 3. LCA: Calculation rules

### 3.1 Declared unit

The declared product is HENSOTHERM® 920 KS / 980 KS. The declared unit refers to one kilogramme of product. Packaging is included in the calculation. The declared unit is given in [kg].

**Declared unit and mass reference**

| Name | Value | Unit |
|---|---|---|
| Gross density (mean value) | 1225 | kg/m$^3$ |
| Declared unit | 1 | kg |

### 3.2 System boundary

Type of EPD: Cradle to factory gate with options, modules C1-C4 and module D. The following information modules are defined as system boundaries in this study:

Production stage (A1-A5):
A1: Raw material extraction
A2: Transport to the manufacturer
A3: Production
A4: Transport to the construction site
A5: Installation in the building

End of Life (C1-C4):
C1: Deconstruction/demolition
C2: Transport
C3: Waste processing
C4: Disposal

Reuse, recovery and recycling potential (D)

In order to accurately record the indicators and environmental impacts of the declared unit, a total of 10 information modules are analysed. Modules A1 to A5 cover the provision of materials, transport to the production site, manufacture of the product, transport to the construction site, and installation in the building.

The preliminary products are sourced from the European Union. Transportation is carried out by truck. The following flow charts illustrate the underlying production process.

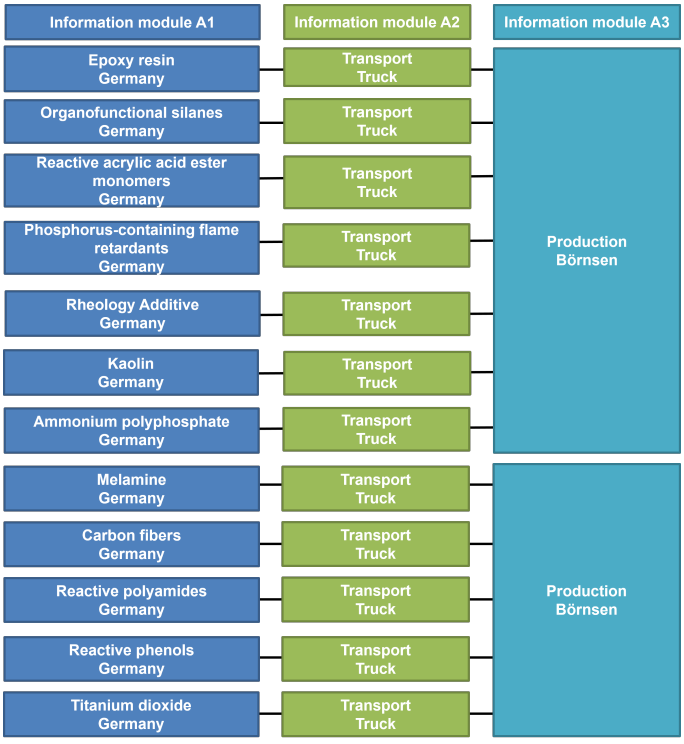


**Figure 1:** Information modules A1 to A3 of the product


**Figure 2:** Information modules A1 to A3 of the packaging

Information modules C1 to C4 cover the dismantling or demolition of the building, transport for waste disposal, waste treatment, and disposal of the product. Furthermore, reuse, recovery and recycling potential is shown in information module D.

### 3.3 Estimates and assumptions

The electricity mixes and underlying data are calculated on a country-specific basis for the production processes.
An assumption was made for the calculation of carbon fibres. No assumptions were made for other substances.

### 3.4 Cut-off criteria

The cut-off criterion according to *EN 15804+A2* is applied. All energy and mass inputs were taken into account.

### 3.5 Background data

The databases used in this study are *LCA for Experts* and *Ecoinvent 3.11*.

### 3.6 Data quality

The assessment of the data quality is classified as appropriate, as the relevant data sets used to calculate the material provision of the declared unit are up to date. Data is provided in LCA for Experts under Data documentation with the respective reference year. Despite the use of different databases *(Sphera, Ecoinvent 3.11)*, a consistent data basis is available, as all requirements for calculating the indicators in accordance with *EN 15804+A2* are met.

### 3.7 Period under review

Specific data from the Börnsen manufacturing plant in Germany was collected for the preparation of the life cycle assessment (LCA). The data for input and output flows is from 2022 and corresponds to the annual average.

### 3.8 Geographic representativeness

Country or region in which the declared product system is manufactured, used or handled at the end of the product's life span: Global

### 3.9 Allocation

The co-products are allocated in information modules A1-A3. The production waste is thermally utilised. The ensuing electrical and thermal energy credits are offset in modules A1-A3. No further allocations are made.

### 3.10 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all data sets to be compared were created according to *EN 15804* and the building context and product-specific performance characteristics are taken into account. The databases used in this study are *LCA for Experts* and *Ecoinvent 3.11*.

## 4. LCA: Scenarios and additional technical information

**Characteristic product properties of biogenic carbon**

No renewable raw materials are used in the product or the packaging. Biogenic carbon is therefore recognised as zero.

**Information describing the biogenic carbon content at the plant gate**

| Name | Value | Unit |
|---|---|---|
| Biogenic carbon in the product | - | kg C |
| Biogenic carbon in the associated packaging | - | kg C |

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of $CO_2$.

**Transport to construction site (A4)**

The transport model is based on a construction site in Europe. A standard distance of 500 km is assumed for the scenario.

The transported quantity comprises the product including the associated packaging as far as the construction site.

| Name | Value | Unit |
|---|---|---|
| Transport distance | 500 | km |
| Weight of transported quantity | 1,224 | kg |

**Installation in the building (A5)**

An airless spraying system for 1-component coatings is used for application to the steel girder.
This uses compressed air for power transmission. The mixed 2-component material is heated to 40.0 °C using a continuous flow heater and pumped in a circle. Approx. 0.1 kg of the coating is lost in the process.
The majority of fire protection coatings are applied off-site in the workshop.

| Name | Value | Unit |
|---|---|---|
| Electricity consumption | 0.249 | kWh |
| Material loss | 0.1 | kg |

**End of Life (C1-C4)**

The demolition of the fire protection coating from the building is calculated in information module C1. Demolition is carried out using an electric tool. The electrical energy consumption for the tool is assumed to be 0.5 MJ for the declared unit. The electricity consumption is calculated using a European electricity mix. The waste treatment results in a mass loss of 3%.

| Name | Value | Unit |
|---|---|---|
| Collected separately waste type | 1 | kg |
| Energy recovery | 0.97 | kg |

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

Thermal utilisation produces electrical and thermal energy, which is reported in module D.

| Name | Value | Unit |
|---|---|---|
| Electrical energy | 1,13 | MJ |
| Thermal energy | 2,62 | MJ |
| Net flow of steel (packaging) | 0,102 | kg |

## 5. LCA: Results

The thermal and electrical energy credits are recognised in C3.

**DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)**

| Product stage | | | Construction process stage | | Use stage | | | | | | | End of life stage | | | | Benefits and loads beyond the system boundaries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Raw material supply | Transport | Manufacturing | Transport from the gate to the 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 | X | X | X | X | X | X | X |

**RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 kg HENSOTHERM 920 / 980 KS**

| Parameter | Unit | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GWP-total | kg $CO_2$ eq | 4.89E+00 | 5.66E-02 | 2.27E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.93E-02 | 4.62E-03 | 1.24E+00 | 0 | -5.16E-01 |
| GWP-fossil | kg $CO_2$ eq | 4.85E+00 | 5.6E-02 | 1.48E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.92E-02 | 4.57E-03 | 4.73E-01 | 0 | -5.17E-01 |
| GWP-biogenic | kg $CO_2$ eq | 3.34E-02 | 0 | 7.88E-02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.48E-05 | 0 | 7.64E-01 | 0 | 6.51E-04 |
| GWP-luluc | kg $CO_2$ eq | 2.88E-03 | 5.79E-04 | 7.43E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.62E-05 | 4.73E-05 | 1.46E-04 | 0 | -1.11E-04 |
| ODP | kg CFC11 eq | 4.42E-08 | 6.63E-15 | 1.52E-12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.6E-13 | 5.41E-16 | 3.97E-13 | 0 | -1.71E-12 |
| AP | mol $H^+$ eq | 3.71E-02 | 5.8E-05 | 2.4E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.03E-04 | 4.74E-06 | 7.12E-04 | 0 | -7.52E-04 |
| EP-freshwater | kg P eq | 5.19E-04 | 1.52E-07 | 4.38E-08 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.9E-08 | 1.24E-08 | 1.26E-07 | 0 | -9.44E-08 |
| EP-marine | kg N eq | 4.77E-03 | 2.02E-05 | 7.14E-05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.79E-05 | 1.65E-06 | 2.74E-04 | 0 | -1.72E-04 |
| EP-terrestrial | mol N eq | 1.26E-01 | 2.1E-04 | 8.04E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.04E-04 | 1.71E-05 | 3.24E-03 | 0 | -1.74E-03 |
| POCP | kg NMVOC eq | 1.02E-02 | 4.72E-05 | 1.93E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.83E-05 | 3.85E-06 | 7.09E-04 | 0 | -5.81E-04 |
| ADPE | kg Sb eq | 1.95E-05 | 3.73E-09 | 8.74E-09 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.09E-09 | 3.05E-10 | 6.84E-09 | 0 | -1.02E-06 |
| ADPF | MJ | 8.04E+01 | 7.16E-01 | 1.93E+00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.26E+00 | 5.85E-02 | 6.58E-01 | 0 | -7.51E +00 |
| WDP | $m^3$ world eq deprived | 7.09E-01 | 2.25E-04 | 2.22E-02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.82E-03 | 1.84E-05 | 1.53E-01 | 0 | -2.08E-02 |

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential)

**RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 kg HENSOTHERM 920 / 980 KS**

| Parameter | Unit | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERE | MJ | 8.31E+00 | 5.27E-02 | 3.78E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.09E-01 | 4.3E-03 | 1.95E-01 | 0 | -4.08E-01 |
| PERM | MJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PERT | MJ | 8.31E+00 | 5.27E-02 | 3.78E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.09E-01 | 4.3E-03 | 1.95E-01 | 0 | -4.08E-01 |
| PENRE | MJ | 6.33E+01 | 7.16E-01 | 3.64E+00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.26E+00 | 5.85E-02 | 1.6E+01 | 0 | -7.51E+00 |
| PENRM | MJ | 1.71E+01 | 0 | -1.71E +00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1.54E +01 | 0 | 0 |
| PENRT | MJ | 8.04E+01 | 7.16E-01 | 1.93E+00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.26E+00 | 5.85E-02 | 6.58E-01 | 0 | -7.51E+00 |
| SM | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.02E-01 |
| RSF | MJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NRSF | MJ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| FW | $m^3$ | 2.24E-02 | 2.54E-05 | 7.96E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.48E-04 | 2.07E-06 | 3.62E-03 | 0 | -1.85E-02 |

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary 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 material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

**RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 kg HENSOTHERM 920 / 980 KS**

| Parameter | Unit | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HWD | kg | 1.6E-08 | 2.59E-11 | 4.67E-10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.51E-10 | 2.12E-12 | 4.16E-10 | 0 | -1.38E-08 |
| NHWD | kg | 6.32E-02 | 9.42E-05 | 8.01E-03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.18E-04 | 7.7E-06 | 7.31E-02 | 0 | 1.98E-02 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RWD | kg | 7.26E-04 | 9.43E-07 | 2.75E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.59E-04 | 7.7E-08 | 1.94E-05 | 0 | -3.6E-04 |
| CRU | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MFR | kg | 0 | 0 | 1.25E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MER | kg | 0 | 0 | 1E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1E+00 | 0 | 0 |
| EEE | MJ | 0 | 0 | 1.16E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.13E+00 | 0 | 0 |
| EET | MJ | 0 | 0 | 2.7E-01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.62E+00 | 0 | 0 |

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

**RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional:**
**1 kg HENSOTHERM 920 / 980 KS**

| Parameter | Unit | A1-A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PM | Disease incidence | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| IR | kBq U235 eq | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| ETP-fw | CTUe | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HTP-c | CTUh | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HTP-nc | CTUh | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SQP | SQP | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

PM = Potential incidence of disease due to PM emissions; IR = Potential human exposure efficiency relative to U235; ETP-fw = Potential comparative toxic unit for ecosystems; HTP-c = Potential comparative toxic unit for humans (carcinogenic); HTP-nc = Potential comparative toxic unit for humans (not carcinogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator “Potential human exposure efficiency relative to U235”. This impact category deals mainly with the eventual impact of low-dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – carcinogenic”, “Potential comparative toxic unit for humans - not carcinogenic”, “potential soil quality index”. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

## 6. LCA: Interpretation

The dominance analysis shows that the main causes of the environmental impacts and indicators can be found in information module A1. This shows the total global warming potential for material provision at approx. 67 % and approx. 17 % for thermal utilisation in module C3, based on all information modules.

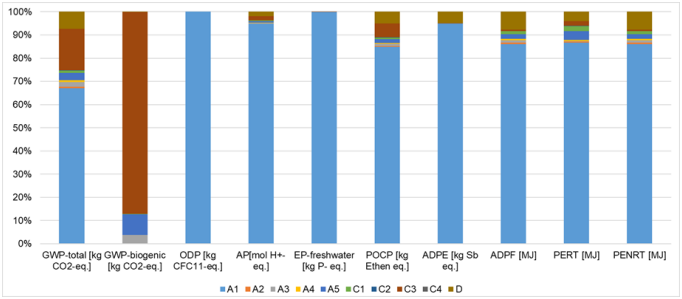


**Figure:** Dominance analysis modules A1 to D

If the provision of materials is considered in detail for the fire protection coating and packaging, it becomes apparent which raw materials make a decisive contribution to the respective environmental impacts and indicators.

The reactive polyamide accounts for approx. 30 % and the epoxy resin for 20 % of the total global warming potential in information module A1. Titanium dioxide accounts for approx. 17 %.

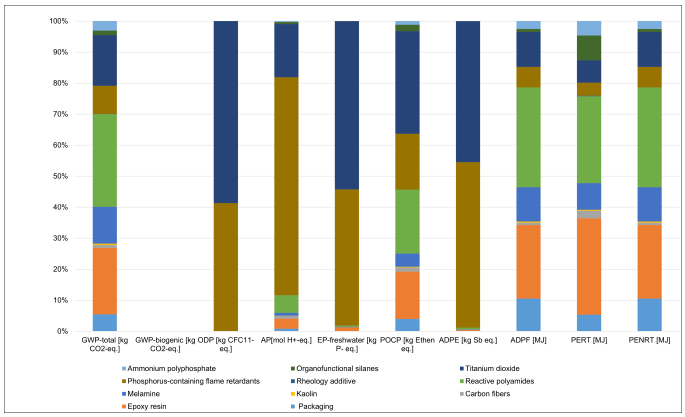


**Figure:** Dominance analysis module A1

Information module A3 clearly shows that approx. 95 % of the total global warming potential is caused by the Hensotherm® 920 KS / 980 KS product and approx. 5 % by the packaging.

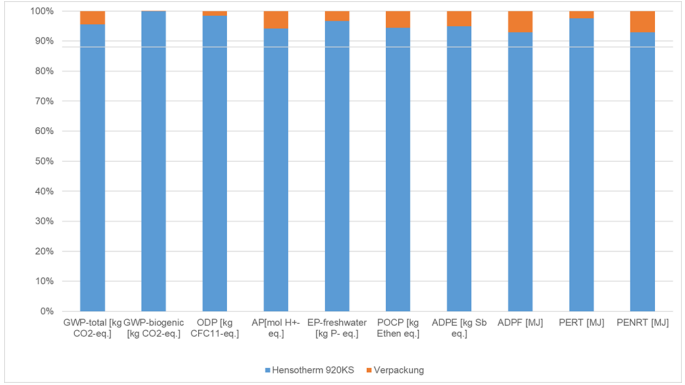

**Figure:** Dominance analysis module A3

## 7. Requisite evidence

HENSOTHERM® 920 KS with and without top coat fulfils the *AgBB* requirements.

HENSOTHERM® 920 KS with and without top coat fulfils the *MVV TB 2021/1* requirements for reactive fire protection systems on steel components.

HENSOTHERM® 920 KS with top coat fulfils the requirements of the *French VOC* classification regulation *French VOC* labelling regulation with emission class A+.

HENSOTHERM® 920 KS with top coat fulfils the criteria of the *French KMR* emissions regulation.

HENSOTHERM® 920 KS with top coat fulfils the criteria of the *Belgian Royal Decree on the limit values for indoor emissions of construction products for specific uses*.

HENSOTHERM® 920 KS with top coat: *Report No. 55907-A001-BVO-L* dated 15 January 2021 and *Report No. 55907-A001-FVO-L* dated 15 January 2021.

**AgBB result overview without top coat (28 days [µg/m³])**

| Name | Value | Unit |
|---|---|---|
| VOC | 120,0 | µg/m³ |
| SVOC | < 5,0 | µg/m³ |
| R (dimensionless) | 0,93 | - |

Test report from Eco-Institut Germany GmbH:

HENSOTHERM® 920 KS without top coat: *Report No. 55816-001-AgBB-L* dated 11 January 2021.

**AgBB result overview with top coat (28 days [µg/m³])**

| Name | Value | Unit |
|---|---|---|
| VOC | 300,0 | µg/m³ |
| SVOC | < 5,0 | µg/m³ |
| R (dimensionless) | 0,55 | - |

Test report from Eco-Institut Germany GmbH:

HENSOTHERM® 920 KS with top coat: *Report No. 55907-001-AgBB-L* dated 15 January 2021.

## 8. References


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Australian Standard 4100:1998, Steel Structures

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DIN EN 15804:2022-03, Sustainability of construction works - Environmental product declarations – Core rules for the product category of construction products

**DIN EN 16516**
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**DIN EN 45545**
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**DIN EN ISO 12944**
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**DIN EN ISO 14040**
DIN EN ISO 14040:2021-02, Environmental management – Life cycle assessment – Principles and framework

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DIN EN ISO 14044:2021-02, Environmental management – Life cycle assessment – Requirements and guidelines

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**EN 13501**
EN 13501-1:2019, Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests
EN 13501-2:2016, Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance and/or smoke control tests, excluding ventilation services

**aBG Nr. Z-19.51-2629**
General type approval dated 24.10.2022 for HENSOTHERM® 920 KS.
Application of the reactive fire protection coating 'HENSOTHERM 920 KS' on steel components

**AgBB**
Evaluation scheme for VOC emissions from indoor-relevant building products (2021)

**AVV**
Ordinance on the European Waste Catalogue (Waste Catalogue Ordinance, AVV), dated 10 December 2001

**EAD 350402-00-1106**
EAD No. 350402-00-1106, Fire protection products: Reactive coatings for the fire protection of steel elements

**ECHA Candidate List**
European Chemical Agency (ECHA), Candidate List: Candidate List of Substances of Very High Concern for Authorisation (published in accordance with Article 59(10) of the REACH Regulation)

**Ecoinvent 3.11**
Background data: ecoinvent 3.11
Zürich:ecoinventhttp://www.ecoinvent.org(014.05.2024)

**ETA Nr. 22/0475**
European Technical Assessment vom 22.09.2022 für HENSOTHERM® 920 KS

**French VOC classification regulation**
'Décret n° 2011-321' (Decree no. 2011-321) and 'Arrêté relatif à l`étiquetage des produits de construction ou de revêtement de mur ou de sol et des peintures et vernis sur leurs émissions de polluants volatils' (Decree on the labelling of construction products, wall or floor coverings, and paints and varnishes on their emissions of volatile pollutants)

**French KMR emissions regulation**
'Arrêté du 28 mai 2009 modifiant l'arrêté du 30 avril 2009 relatif aux conditions de mise sur le marché des produits de construction et de décoration contenant des substances cancérigènes, mutagènes ou reprotoxiques de catégorie 1 ou 2' (Order of 28 May 2009 amending the order of 30 April 2009 on the conditions for placing on the market construction and decoration products containing category 1 or 2 carcinogenic, mutagenic or reprotoxic substances)

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General instructions for the EPD programme of Institut Bauen und Umwelt e.V., version 2.1, Berlin: Institut Bauen und Umwelt e.V., 2022, www.ibu-epd.com

**Royal Decree establishing the limit values for emissions into the interior of construction products for certain intended uses**
Draft dated December 2012: KINGDOM OF BELGIUM – Federal Public Service Health, Food Chain Safety and Environment

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Model administrative regulation for technical building regulations dated 17 January 2021

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Product category rules for building-related products and services – Part A: Calculation rules for the Life Cycle Assessment and requirements for the background report, V1.4, Institut Bauen und Umwelt e.V., April 2024

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**Publisher**

Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

**Programme holder**

Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

+49 (0)30 3087748- 0
info@ibu-epd.com
www.ibu-epd.com

**Author of the life cycle assessment**

FIT-Umwelttechnik GmbH
Westerstr. 13
38442 Wolfsburg
Germany

05362 72 69 474
bertram@fit-umwelttechnik.de
www.fit-umwelttechnik.com

**Owner of the Declaration**

Rudolf Hensel GmbH
Lauenburger Landstraße 11
21039 Börnsen
Germany

+49 (0)40 7210 6210
info@rudolf-hensel.de
www.rudolf-hensel.de