

ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804+A1

Owner of the Declaration	Lanxess Deutschland GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-LAN-20210301-IBG1-EN
Issue date	07.01.2022
Valid to	06.01.2027

BAYFERROX® 330 – Iron Oxide Black Pigment (Fe₃O₄)
Lanxess Deutschland GmbH

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1. General Information

<p>LANXESS Deutschland GmbH</p> <hr/> <p>Programme holder IBU – Institut Bauen und Umwelt e.V. Hegelplatz 1 10117 Berlin Germany</p> <hr/> <p>Declaration number EPD-LAN-20210301-IBG1-EN</p> <hr/> <p>This declaration is based on the product category rules: Inorganic Pigments in Various Forms of Delivery, 03.2021 (PCR checked and approved by the SVR)</p> <hr/> <p>Issue date 07.01.2022</p> <hr/> <p>Valid to 06.01.2027</p> <hr/> <p></p> <hr/> <p>Dipl. Ing. Hans Peters (chairman of Institut Bauen und Umwelt e.V.)</p> <hr/> <p></p> <hr/> <p>Dr. Alexander Röder (Managing Director Institut Bauen und Umwelt e.V.)</p>	<p>BAYFERROX® 330</p> <hr/> <p>Owner of the declaration Lanxess Deutschland GmbH BU Inorganic Pigments Chempark Krefeld-Uerdingen, Gebäude R54 Rheinuferstr. 7-9 47829 Krefeld</p> <hr/> <p>Declared product / declared unit 1,000 kg BAYFERROX® 330 iron oxide black pigment (weighted average)</p> <hr/> <p>Scope: This EPD applies to the iron oxide black pigments BAYFERROX® 330 in the versions compacted (330 C), powder (330), and granulate (330 G). It is an average EPD for which the weighted average of the three versions was calculated on the basis of the mass-specific production rate of the last five years (2016–2020). Production of the pigments in Germany was assessed.</p> <p>The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences. The EPD was created according to the specifications of <i>EN 15804+A1</i>. In the following, the standard will be simplified as <i>EN 15804</i>.</p> <hr/> <p>Verification</p> <table border="1"> <tr> <td colspan="2">The standard <i>EN 15804</i> serves as the core PCR</td> </tr> <tr> <td colspan="2">Independent verification of the declaration and data according to <i>ISO 14025:2011</i></td> </tr> <tr> <td><input type="checkbox"/> internally</td> <td><input checked="" type="checkbox"/> externally</td> </tr> </table> <hr/> <p></p> <hr/> <p>Matthias Klingler (Independent verifier)</p>	The standard <i>EN 15804</i> serves as the core PCR		Independent verification of the declaration and data according to <i>ISO 14025:2011</i>		<input type="checkbox"/> internally	<input checked="" type="checkbox"/> externally
The standard <i>EN 15804</i> serves as the core PCR							
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2. Product

2.1 Product description/Product definition

Inorganic pigments are defined as substances that are insoluble in the application medium *ISO 18451-1* and manufactured by means of chemical synthesis. This EPD covers the product Bayferrox® 330 in its typical versions, namely powder, granulate, and compacted. The average values of the inorganic pigments declared here are based on the product volume in the indicated versions.

Regulation (EU) no. 305/2011 (CPR) applies to the placing of the product on the market in the EU/EFTA (except Switzerland). The product requires a declaration of performance with due consideration of *DIN EN 12878:2014 Pigments for the coloring of building materials based on cement and/or lime - Specifications and methods of test*, and CE marking. The respective national provisions apply to use.

2.2 Application

Inorganic iron oxide pigments are used for coloring building materials made from cement, cement/lime mixtures, lime mortar, and bituminous applications.

2.3 Technical Data

The product technical data that comes within the scope of the EPD is set out in the table below, with reference to the check rules based on *EN 12878*.

Structural data – influence on concrete properties

Name	Value	Unit
Setting time Setting time (start of setting at least 1 h)	177	min
Setting time Setting time (end of setting max. 12 h)	269	min
Influence on cement setting Influence on cement setting Delta mix with and without pigment max. +/- 60 min	22	min

Compressive strength Compressive strength (mortar 28 days comparison of mix with and without pigment; category A)	-0.6	N/mm ²
Compressive strength Compressive strength (mortar 28 days comparison of mix with and without pigment; category B max.-8%)	0.9	N/mm ²
Chloride content Chloride content (total chloride; category A)	0.08	%
Chloride content Chloride content (total chloride; category B max. 0.1%)	0.06	%
Soluble chloride content Amount of soluble chloride category A	0.05	%
Soluble chloride content Amount of soluble chloride (total chloride; category B max. 0.1%)	0.03	%
Content of water-soluble substances Amount of water-soluble substances (category A)	1.57	%
Content of water-soluble substances Amount of water-soluble substances (category B max. 0.5%)*	1.62	%

*) Provided that the water-soluble content complies with EN 934-1.

The amount of water-soluble substances as defined by EN 934-1, paragraph 5.2.3, must not exceed:

- Category A: the level stated by the manufacturer
- Category B: 0.5% by mass for individual pigments and pigment mixtures. If additives such as dispersants, binders, and/or grinding aids are used for powder or non-powder preparations, their water-soluble total content must be equal to or less than 5.5% by mass (8.0% for carbon black) in relation to the solid. The additives used must comply with EN 934-1, annex A.1.

The extremal values (worst-case assessment) across the three assessed versions are used to prove conformity with the standard.

Performance figures for the product in line with the declaration of performance in relation to its key characteristics as per *DIN EN 12878:2014 Pigments for the coloring of building materials based on cement and/or lime - Specifications and methods of test*.

2.4 Delivery status

Typical versions of BAYFERROX® 330 are powder, compacted, and granulate. The packaging typically ranges from 25 kg polyethylene (PE)/paper sacks to big bags with a net weight of one metric ton. The calculations in this EPD are based on an assessment of big-bag material. As the packaging material accounts for a very small proportion of the calculated environmental impacts, only big bags made from polypropylene (PP) and low-density polyethylene (LDPE) were assessed as the packaging variant.

2.5 Base materials/Ancillary materials

Name	Value	Unit
Iron filings	34,5	Masse-%
Direct reduced iron	17,3	Masse-%
Sulfuric acid	0,5	Masse-%
Iron (II) chloride solution	14,2	Masse-%
Phosphoric acid	0,1	Masse-%
Sodium hydroxide	0,001	Masse-%
Nitrobenzene	30,9	Masse-%
Cooling water	2,6	Masse-%

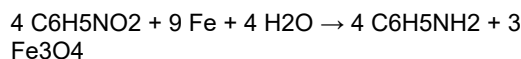
1) The product/at least one partial product contains substances on the ECHA list of substances of very high concern (SVHC) (date July 8, 2021) above 0.1% by mass: No.

2) The product/at least one partial product contains further CMR substances in category 1A or 1B that are not on the candidate list, above 0.1% by mass in at least one partial product: No.

3) This construction product has had biocidal products added to it, or it has been treated with biocidal products (it is therefore a treated article as per the Biocidal Products Regulation (EU) no. 528/2012): No.

2.6 Manufacture

The product is manufactured using the Laux process, which yields high-quality iron oxide pigments by reducing nitrobenzene with iron. Cast-iron filings, a waste product in the steel-processing industry, are used as a raw material. The exothermic reaction is controlled in such a way that Fe₃O₄ is obtained.



The aniline is removed from the reaction mixture via steam distillation. The residual iron is separated by means of a centrifugal separator. The remaining mixture is concentrated further and washed in order to separate soluble components.

2.7 Environment and health during manufacturing

LANXESS is continuously investing in modern manufacturing processes at all locations. The Inorganic Pigments business unit and its equipment are certified according to *ISO 9001, 14001, and 50001*. BAYFERROX® iron oxide pigments are certified by SCS Global Services for their high content of recycled raw materials.

2.8 Product processing/Installation

As this EPD assesses modules A1–A3 and D (cradle to gate), a rough description of the application processes is attached.

Customers typically use dosing units to dose BAYFERROX® 330 into specific color mixtures and to process them into cement-bound, lime-bound, or bituminous products.

2.9 Packaging

All versions of the pigment BAYFERROX® 330 are packaged identically. The finished product is usually

packaged in PE/paper sacks with a net weight of 25 kg through to big bags made of PP and LDPE with a net weight of one metric ton.

According to the German Association for Plastics Packaging and Films (IK), the big bags made of PP and LDPE on which the calculations of the EPD are based can be reused in a closed-loop system under specific conditions for the same product (max. 2 years). The big bags can be recycled at the end of their life. For mechanical recycling, the used synthetic fabrics are treated mechanically with no change to the chemical structure. The recycled materials can be used in various applications and replace new granulate.

2.10 Condition of use

This EPD assesses modules A1–A3 and D (cradle to gate). No material changes are expected within the recommended usage limits.

2.11 Environment and health during use

The product is not a hazardous substance (as per the *CLP Regulation*). There is no risk if the product is handled and processed in compliance with the applicable regulations in the workplace.

2.12 Reference service life

This EPD assesses modules A1–A3 and D (cradle to gate). The service life corresponds to typical use in the respective application.

2.13 Extraordinary effects

Fire

Fe₃O₄ is non-flammable. The product is not classified according to the *CLP Regulation*.

Water

No hazardous substances are released as a result of contact with water.

Mechanical destruction

Not applicable.

2.14 Re-use phase

This EPD assesses modules A1–A3 and D (cradle to gate). As BAYFERROX® 330 is bound in the application medium, reuse is not pursued on account of the substantial amount of thermal energy required and the technical options currently available. Recycling management provides individual opportunities for use of the bound pigment.

2.15 Disposal

Disposal is carried out in conjunction with and in accordance with the respective application medium. The waste code for iron oxide is 060316 (as per the *German Waste Catalog Ordinance*).

2.16 Further information

Further information on BAYFERROX® 330 and further Lanxess IPG products and services is available at www.bayferrox.com.

3. LCA: Calculation rules

3.1 Declared Unit

The selected declared unit relates to an average product. The average was formed as a weighted mean from the annual production quantities of the compacted, powder, and granulate versions over the last five years (2016–2020) (reference to mass).

Declared Unit

Name	Value	Unit
Declared unit	1000	kg
Gross density	-	kg/m ³
Conversion factor [mass/declared unit]	1000	

3.2 System boundary

The following modules were taken into account in the LCA calculation:

- A1: Supply of raw materials
- A2: Transportation of raw materials to the manufacturer
- A3: Manufacture of the product (including required energy and water) and manufacture of the product packaging
- D: Reuse, recovery, and/or recycling potential

The use and disposal phase is not taken into account in the LCA calculations.

3.3 Estimates and assumptions

Primary data across all versions was used for transportation of the iron filings and sodium hydroxide (module A2) and for on-site production processes at Lanxess Deutschland GmbH (module A3). A distance of 1,000 km (within Europe) was assumed for transportation of all further input materials (module A2). Electricity consumption of 0.072 MJ per tkm was assumed for transportation via pipeline.

Generic data was used for production of feedstocks (module A1) as these are not produced by Lanxess Deutschland GmbH itself and no detailed information was available.

Credits for the avoidance of generation of electricity and steam in another product system through the incineration processes for production waste were also taken into account (module D). 100% incineration including energy recovery (electricity and steam) was assumed here.

3.4 Cut-off criteria

All primary data of the production processes was taken into account. No cut-off rules were applied.

3.5 Background data

The software system GaBi 9 developed by Sphera was used for modeling of the product's LCA. The data sets contained therein are either from the *GaBi Professional database* or from the *Ecoinvent database* (v 3.5).

3.6 Data quality

The GaBi software system for life-cycle analyses and the *GaBi Professional database* as well as the *Ecoinvent database* (v 3.5) were used for life-cycle modeling of the assessed products. The produced quantities for 2020 were gathered by Lanxess.

Corresponding data sets were available for the precursors used, and some of them have been adapted with regard to concentration. The age of the background data used (2016–2020) is less than 15 years and can be regarded as representative for the assessment period.

The LCA figures for the average EPD (weighted mean over the last 5 years (2016–2020)) can be regarded as robust as they are a weighted average of high-quality, measured activity data. All data used can be regarded as representative.

3.7 Period under review

The assessment period is 2020. All in-house data was gathered in this period and then correspondingly subjected to average weighting for the average assessment.

3.8 Allocation

For the iron filings used, only the expenses for treatment are taken into account in module A1 as they relate to pre-consumer material as per *ISO 14021*.

Aniline is a co-product in the manufacture of the iron oxide black pigment. In line with the requirements of *EN 15804* (section 6.4.3.2), an allocation based on physical properties (mass) was carried out in modules A1 and A3. 71% of the material flows were assigned to the product.

All credits from recovered energy from processes relating to the incineration of production waste were allocated to module D.

3.9 Comparability

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

Background data was taken from the *GaBi Professional database*. To fill occasional gaps, data sets from *Ecoinvent* (v 3.5) were used.

4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules or can be used to develop specific scenarios in the context of a building assessment if modules are not declared (MND).

As disposal of the packaging material on the building site (module A5) is not declared, the assessed quantities of packaging materials are stated below:

- Big bag (PP): 1.90 kg/1,000 kg product
- Big bag (LDPE): 0.95 kg/1,000 kg product

Module D comprises the credits for the incineration processes (i.e. credits for electricity and steam as a result of incineration of production waste). The credits are based on German average data for electrical and thermal energy.

5. LCA: Results

The following tables show the environment-relevant results as per *EN 15804* for 1,000 kg BAYFERROX® 330 iron oxide black pigment (weighted average for the compacted, powder, and granulate versions). Module D sets out the incineration of production waste and reflects thermal treatment with energy recovery.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE 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	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A1: 1.000 kg BAYFERROX® 330 (Durchschnittsprodukt)

Parameter	Unit	A1	A2	A3	D
Global warming potential	[kg CO ₂ -Eq.]	8.59E+2	1.20E+1	6.52E+2	-3.43E+1
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	5.83E-6	2.28E-13	8.48E-12	-9.26E-13
Acidification potential of land and water	[kg SO ₂ -Eq.]	1.74E+0	1.99E-2	4.40E-1	-2.88E-2
Eutrophication potential	[kg (PO ₄) ³ -Eq.]	3.62E-1	4.48E-3	8.01E-2	-5.48E-3
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	1.93E-1	-4.34E-3	4.71E-2	-2.95E-3
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.49E-3	2.75E-6	9.95E-5	-9.48E-6
Abiotic depletion potential for fossil resources	[MJ]	2.24E+4	1.47E+2	7.81E+3	-4.59E+2

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A1: 1.000 kg BAYFERROX® 330 (Durchschnittsprodukt)

Parameter	Unit	A1	A2	A3	D
Renewable primary energy as energy carrier	[MJ]	5.26E+2	4.39E+1	1.46E+3	-1.55E+2
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	5.26E+2	4.39E+1	1.46E+3	-1.55E+2
Non-renewable primary energy as energy carrier	[MJ]	2.27E+4	1.59E+2	9.35E+3	-5.04E+2
Non-renewable primary energy as material utilization	[MJ]	1.03E+3	2.63E-10	1.25E+2	-5.67E-10
Total use of non-renewable primary energy resources	[MJ]	2.38E+4	1.59E+2	9.48E+3	-5.04E+2
Use of secondary material	[kg]	4.36E+2	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m ³]	2.61E+0	2.16E-2	1.10E+0	-6.66E-2

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A1: 1.000 kg BAYFERROX® 330 (Durchschnittsprodukt)

Parameter	Unit	A1	A2	A3	D
Hazardous waste disposed	[kg]	4.96E-6	4.04E-6	4.13E-6	-2.68E-7
Non-hazardous waste disposed	[kg]	9.03E+0	6.11E-2	1.41E+1	-2.44E-1
Radioactive waste disposed	[kg]	7.89E-2	4.39E-3	1.90E-1	-1.76E-2
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	1.16E+2	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	2.69E+2	0.00E+0

The environment-relevant results (use of resources, output flows, and waste categories) as per *EN 15804* for 1,000 kg BAYFERROX® 330 iron oxide black pigment in the individual versions (compacted, powder, granulate) are set out in the annex.

6. LCA: Interpretation

The product is evaluated below for the weighted average of the three versions, namely compacted, powder, and granulate.

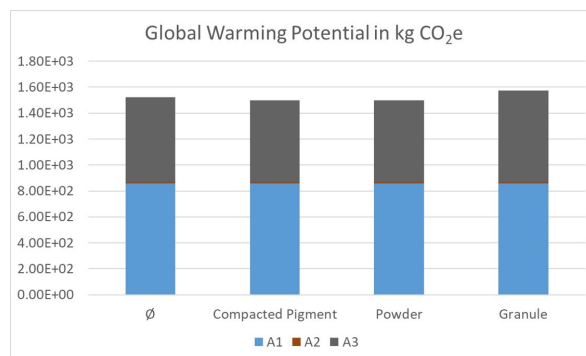
All impact categories are substantially characterized by the provision of raw materials (module A1) and production (module A3), with a relevance of 99%.

The main drivers in terms of global warming potential (GWP) and potential for depletion of abiotic resources in the raw materials (module A1) are predominantly the nitrobenzene used (67% and 79%, respectively, in module A1) and the direct reduced iron (25% and 17%, respectively, in module A1).

Compared with the other modules, transportation processes (module A2) have very little influence on the impact categories (approx. 1%). Furthermore, the separate evaluation of energy recovery (module D) results in credits in all impact categories.

Provision of raw materials accounts for the biggest proportion of the gross energy requirement (PENRT + PERT) of approx. 24,300 MJ (module A1). Approx. 660 MJ is credited for energy recovery (module D) in the production-waste incineration process.

The GWP for the average product and for the three versions is shown in the chart below. While the GWP figures for compacted pigment and powder are almost identical, the figure for granulate is approx. 74 kg CO₂e higher. This is because of the more energy-intensive manufacturing process (module A3).



The results of the LCA impact categories across all three versions of the product are set out in the chart below.

LCA Results	Compacted Pigment	Powder	Granule
GWP [kg CO ₂ eq.]	1.50E+03	1.50E+03	1.57E+03
ODP [kg R11 eq.]	5.83E-06	5.83E-06	5.83E-06
AP [kg SO ₂ eq.]	2.18E+00	2.18E+00	2.23E+00
EP [kg Phosphate eq.]	4.44E-01	4.44E-01	4.53E-01
POCP [kg Ethene eq.]	2.34E-01	2.33E-01	2.40E-01
ADPe [kg Sb eq.]	1.59E-03	1.59E-03	1.60E-03
ADPF [MJ]	3.01E+04	3.00E+04	3.12E+04

7. Requisite evidence

No proof has to be provided for this EPD as no hazardous substances as per the *CLP Regulation* are used.

8. References

Standards

EN 934-1

DIN EN 934-1:2008-04, Admixtures for concrete, mortar, and grout - Part 1: Common requirements.

EN 12878

DIN EN 12878:2014, Pigments for the coloring of building materials based on cement and/or lime - Specifications and methods of test.

EN 15804

DIN EN 15804:2012-04+A1 2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

ISO 9001

DIN EN ISO 9001:2015, Quality management systems – Requirements.

ISO 14001

DIN EN ISO 14001:2015, Environmental management systems - Requirements with guidance for use

ISO 14021

DIN EN ISO 14021:2016, Environmental labels and declarations – Self-declared environmental claims (Type II environmental labeling).

ISO 14025

DIN EN ISO 14025:2011-10, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

ISO 18451-1

DIN EN ISO 18451-1:2019, Pigments, dyestuffs, and extenders - Terminology - Part 1: General terms.

ISO 50001

DIN EN ISO 50001:2018, Energy management systems - Requirements with guidance for use.

Further literature

German Waste Catalog Ordinance (AVV)

Ordinance on the European List of Waste, Waste Catalog Ordinance dated December 10, 2001 (German Federal Gazette I p. 3379), last amended by Article 1 of the Ordinance dated June 30, 2020 (German Federal Gazette I p. 1533).

CLP Regulation

Regulation (EG) no. 1272/2008 of the European Parliament and of the Council of December 16, 2008, on classification, labeling, and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) no. 1907/2006 (Official Journal L 353 dated December 31, 2008, p. 1–1355), last amended by Delegated Regulation (EU) 2021/1962 of the Commission dated August 12, 2021 (Official Journal L 400/16).

Ecoinvent database

Ecoinvent database version 3.5, 2020

GaBi Professional database

GaBi Professional database version 9.2.1, 2020

IBU 2021

Institut Bauen und Umwelt e.V.: General guide for the EPD program of the Institut Bauen und Umwelt e.V. (IBU). Version 2.0, Berlin: Institut Bauen und Umwelt e.V., 2021.
www.ibu-epd.com

PCR part A

Product category rules for building-related products and services. Part A: Calculation rules for the LCA and requirements for the background report, v. 2.0. Berlin: Institut Bauen und Umwelt e.V. (publisher), 2021.

PCR: Inorganic pigments in different versions

Product category rules for building-related products and services. Part B: Requirements for the EPD for inorganic pigments in different versions, v.1.0. Berlin: Institut Bauen und Umwelt e.V. (publisher), 2021.

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