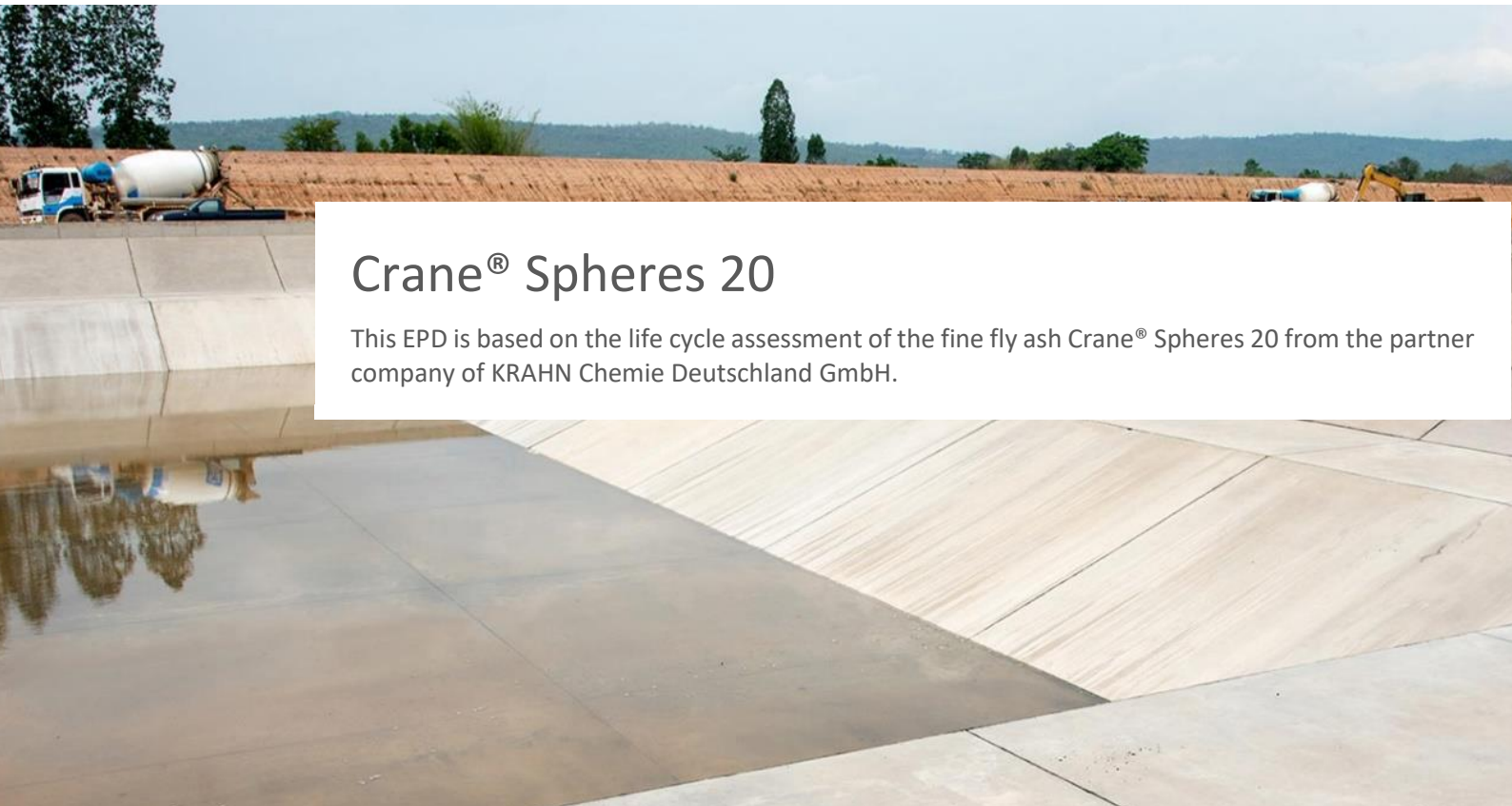
Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of declaration:	KRAHN Chemie Germany GmbH
Publisher:	Kiwa GmbH - Ecobility Experts
Programme operater:	Kiwa GmbH - Ecobility Experts
Registration number:	EPD-KRAHN-220-EN
Date of issue:	13.04.2022
Valid until:	12.04.2027



Crane® Spheres 20

This EPD is based on the life cycle assessment of the fine fly ash Crane® Spheres 20 from the partner company of KRAHN Chemie Deutschland GmbH.

1. General information

KRAHN Chemie Germany GmbH

Programme operator
Kiwa-Ecobility Experts
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13355 Berlin
Germany

Registration number
EPD-KRAHN-220-EN

Issue Date
13.04.2022

Scope
This EPD is based on the life cycle assessment of the fine fly ash Crane® Spheres 20 from the partner company KRAHN Chemie Deutschland GmbH.
The declaration holder is liable for the underlying information and evidence. Kiwa-Ecobility Experts is not liable for manufacturer information, life cycle assessment data and evidence.

Frank Huppertz
(President of Kiwa-Ecobility Experts)

Prof. Dr Frank Heimbecher
(Chairman of the independent expert panel Kiwa-Ecobility Experts)

Crane® Spheres 20

Owner of declaration
KRAHN Chemie Germany GmbH
Grimm 10
20457 Hamburg
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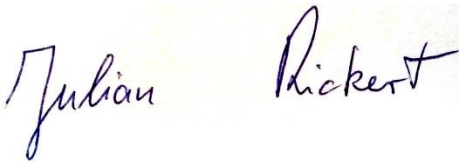
Declared product / declared unit
1 t fly ash

Valid until
12.04.2027

Product category rules
PCR A - Calculation rules for the LCA and requirements for the background report
PCR B - Environmental Product Declaration Requirements for Fly Ash (Draft 2021)

Verification
The CEN standard EN 15804:2012+A2:2019 serves as the core PCR.
Independent verification of the declaration and data according to ISO 14025:2010.
☐internal ☒external



Julian Rickert
(External verifier from GreenDelta GmbH)

2. Product details

2.1 Product description

Crane® Spheres 20 is the fine fly ash produced by special processing by KRAHN Chemie's partner company. It is used as a certified additive for the production of cement-bound high-performance building materials. Due to the high fineness and the defined particle sizes, Crane® Spheres 20 can be used to optimise the grading curves in the fine particle range, which on the one hand improves the rheological properties of glues, mortars and concretes and on the other hand increases the packing density of the building materials. Since Crane® Spheres 20 can be processed just as safely as conventional hard coal fly ash, the production of the high-performance building materials is simple and uncomplicated. Crane® Spheres 20 is a fly ash produced by sifting in fineness category S according to EN 450-1 with a defined maximum grain size of 20 µm.

2.2 Application

Due to these defined properties, Crane® Spheres 20 is particularly suitable for the production of mortars and concretes that are subject to extremely high chemical and mechanical-physical stresses, as well as for the production of high-strength and easily or self-compacting building materials, injection building materials and fine binders for grouting. Other areas of application include grouting and levelling compounds as well as spray and repair mortars.

Crane® Spheres are suitable as fillers in PVC applications, e.g. heavy films, and are used as technical additives in e.g. polyamide and polypropylene in addition to glass fibres. Here, CRANE Spheres can improve the mechanical properties.

Also in adhesives and sealants, the Crane® Spheres products improve the mechanical properties such as the tensile-shear strength. In addition, the spherical shape has a positive effect on the rheological properties.

2.3 Technical data

In Table 1 the technical data for Crane® Spheres 20 are listed.

Table 1: Technical data for Crane® Spheres 20

Parameter	Value	Unit
Specific surface area according to Blaine	7.300	cm^2 /g
Grain bulk density	2,55	kg/dm^3
SiO_2 reactive	45	m.-%
SiO_2 total	54	m.-%
$Al_2 O_3$	25	m.-%
$Fe_2 O_3$	6	m.-%
CaO total	4	m.-%
C	2	m.-%
$K_2 O$	2	m.-%
MgO	2	m.-%
$Na_2 O$	1	m.-%
SO_3	1	m.-%
Trace elements	3	m.-%
Density (EN 1097-6)	2,3 (2,0 - 2,6)	g/cm^3
Bulk density (EN1097-3)	1,0 (0,8 - 1,2)	g/cm^3

2.4 Production

KRAHN Chemie's partner company transports the raw material from the power plant in Datteln to Scholven for processing. There, the coarse material is first separated with the help of a separator and collected in a silo for fly ash. The fines are separated from the remaining material with the help of a cyclone and an ultra-fine filter. The fines are either collected in silos for the loose sale of Crane® Spheres 20, in big bags, in deposit hobbocks or filled into paper bags in Dülmen. Euro exchange pallets are used to transport the packaged Crane® Spheres 20.

2.5 Raw materials

The fly ash used as raw material for Crane® Spheres 20 is obtained from the combustion of hard coal and, if necessary, with the use of co-combustibles

2.6 Reference service life (RSL)

Since only the production phase is considered for products such as fly ash, there is no need to specify a reference service life for the use phase.

2.7 Placing on the market

Crane® Spheres 20 is a grey-black to grey-brown, finely divided powder which has no odour. There are no hazards with regard to reactivity. It is stable under normal conditions. There are no special requirements for conditions and there are no known incompatible materials. There is no potential health hazard and no environmental toxicity as the substance is classified as non-hazardous. It is not a dangerous substance according to ADR (transport of dangerous goods by road), IMDG (maritime transport) and IATA (air transport).

Crane® Spheres 20 is delivered 50% loose, 25% in big bags, 24% in paper bags and 1% in hobbocks. The filled big bags, paper sacks and hobbocks are transported to the place of use on Euro exchange pallets.

3. LCA: Calculation rules

3.1 Declared unit

The declared unit for fly ash is 1,000 kg or 1 t according to "PCR B - Requirements for Environmental Product Declarations for Fly Ash (Draft July 2021)".

Parameter	Value	Unit
Declared unit	1	t
Conversion factor to 1 kg	0,001	t/kg

3.2 System boundaries

The EPD was prepared in accordance with DIN EN 15804 and takes into account the manufacturing phase. This corresponds to the product phases A1 to A3. The type of EPD is therefore "from the cradle to the factory gate".

Since the following three conditions from DIN EN 15804 are fulfilled, modules C1 to C4 and D do not have to be declared in addition to modules A1 to A3:

- Fly ash is physically combined with other products during installation in such a way that it cannot be physically separated from them during disposal
- Fly ash is no longer identifiable during disposal due to physical or chemical transformation processes
- Fly ash contains no biogenic carbon

A life cycle assessment is unnecessary, as the products and services generally concern the end of the life cycle (fly ash) or the beginning (use as building materials) of the power plant by-products. The fly ashes used as building materials substitute natural products and can be recycled as mineral residues after use.

In this life cycle assessment according to ISO 14025, the following phases of the product life cycle were considered:

- A1: Raw material extraction and processing
- A2: Transport to the manufacturer
- A3: Production

For the declared life phases, all inputs (raw materials, intermediate products, energy and auxiliary materials) as well as the waste produced were considered.

3.3 Assumptions and estimates

For data protection reasons, the assumptions made and data used are only explained in the background report accompanying this EPD.

3.4 Period under review

All product- and process-specific data were collected for the 2020 operating year and are therefore up-to-date.

3.5 Cut-off criteria

Potential environmental impacts were assigned to the material flows based on the Ecoinvent database version 3.6. All flows contributing to more than 1 percent of the total mass, energy or environmental impacts of the system were considered in the LCA. It can be assumed that the neglected processes would have contributed less than 5 percent to the impact categories considered.

Other operating resources and the corresponding waste were not considered part of the product system and accordingly not included in the balancing.

3.6 Data quality

To ensure the comparability of the results, only consistent background data from the Ecoinvent database version 3.6 was used in the LCA (e.g. data sets on energy, transport, auxiliary and operating materials). The database is regularly checked and thus complies with the requirements of EN 15804 (background data not older than 10 years). Almost all consistent data sets contained in the Ecoinvent database version 3.6 are documented and can be viewed in the online documentation.

The raw material data were converted into reference flows (input per declared unit).

The general rule was followed that specific data from specific production processes or average data derived from specific processes must have priority in the calculation of an LCA. Data for processes over which the manufacturer has no influence were assigned generic data.

Ecoinvent database version 3.6 (2019) was chosen as the database. The calculation of the LCA was carried out using Nibe's online EPD application.

The foreground data was provided by KRAHN Chemie's partner company.

3.7 Allocations

For fly ash for concrete according to EN 450-1 with European origin, the following allocation rule applies: Expenses of the power plant operation are to be allocated completely to electricity and heat generation, since the main purpose of the process in which hard coal fly ash is produced as waste is the generation of electrical and thermal energy. Within the power plant process, hard coal fly ash reaches the end of its waste property after the electrostatic precipitator in the power plant. Therefore, the expenses of power plant operation are to be allocated entirely to electricity and heat generation. Expenses for storage, conformity testing and transport within the power plant as well as all expenses in connection with further processing/refining after the electrostatic precipitator are added to hard coal fly ash. The system boundary is the finished product at the plant gate. This was taken into account in the preparation of this EPD.

In addition to Crane® Spheres 10 and Crane® Spheres 20, coarser fly ash is also produced during production, which is used or sold elsewhere. Therefore, an allocation was carried out in the provision of raw materials and electricity consumption during production. For data protection reasons, the details of the assumptions made regarding the allocation are only included in the background report to this EPD.

Specific information on allocations within the background data is provided in the documentation of the Ecoinvent database version 3.6 datasets. There are no allocations during the manufacturing phase of Crane® Spheres 20 at the factory.

3.8 Comparability

A comparison or evaluation of EPD data is only possible if all data sets to be compared have been created according to EN 15804 and the building context or the product-specific performance characteristics are taken into account.

3.9 Data collection

ISO 14044 section 4.3.2 was taken into account in the data collection.

The objective and the scope of the study were defined in consultation with the partner company KRAHN Chemie. The data collection was carried out using an Excel data collection template provided by Kiwa GmbH. The collected data was checked by Kiwa GmbH, for example by critically questioning the assumptions made by the partner company of KRAHN Chemie. In this way, some errors (e.g. unit errors) could still be corrected in cooperation with the partner company of KRAHN Chemie. Subsequently, the annual values were related to the declared unit of one tonne of Crane® Spheres 20 with the help of corresponding calculations. In addition, suitable assumptions were made and estimates carried out for the missing information and data.

3.10 Calculation method

For the life cycle assessment, the calculation procedures described in ISO 14044 section 4.3.3 were applied. The evaluation is carried out on the basis of the phases lying within the system boundaries and the processes contained therein.

4. LCA: scenarios and further technical information

No scenarios were used in the EPD.

5. LCA: Results

The following tables show the results of the life cycle assessment, more precisely for the environmental impact indicators, resource consumption, output flows and waste categories. The results presented here refer to the declared unit of 1 t Crane® Spheres 20.

The results of the environmental impact indicators ETP-fw, HTP-c, HTP-nc, SQP, ADP-f, ADP-mm and WDP must be used with caution, as the uncertainties in these results are high or there is limited experience with the indicator.

The IRP impact category mainly addresses the potential effect of low dose ionising radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposure, nor does it consider the disposal of radioactive waste in underground facilities. Potential ionising radiation from soil, radon and some building materials is also not measured by this indicator.

Specification of the system boundaries (X = module declared; - = module not declared)																
PRODUCTION PHASE			ERECTION PHASE		USE PHASE							DISPOSAL PHASE				Credits and loads outside the system boundaries
Raw material supply	Transport	Production	Transport	Construction / Installation	Use	Maintenance	Repair	Replacement	Conversion / Renewal	Operational energy use	Operational water use	Demolition	Transport	Waste treatment	Landfill	Reuse-, Recovery, Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2: Results of the life cycle assessment - environmental impact indicators: 1 t Crane® Spheres 20

Indicator	Unit	A1	A2	A3
AP	mol H+-eq.	0,00E+00	5,30E-02	5,56E-02
GWP-total	kg CO2-eq.	0,00E+00	9,14E+00	1,63E+01
GWP-b	kg CO2-eq.	0,00E+00	4,22E-03	-1,84E+00
GWP-f	kg CO2-eq.	0,00E+00	9,13E+00	1,81E+01
GWP-luluc	kg CO2-eq.	0,00E+00	3,35E-03	2,32E-02
ETP-fw	CTUe	0,00E+00	1,23E+02	2,04E+02
PM	Occurrence of diseases	0,00E+00	8,22E-07	3,78E-07
EP-m	kg N-eq.	0,00E+00	1,87E-02	9,80E-03
EP-fw	kg PO4-eq.	0,00E+00	9,21E-05	2,41E-03
EP-t	mol N-eq.	0,00E+00	2,06E-01	1,41E-01
HTP-c	CTUh	0,00E+00	3,98E-09	4,62E-09
HTP-nc	CTUh	0,00E+00	1,34E-07	1,44E-07
IRP	kBq U235-eq.	0,00E+00	5,77E-01	8,40E-01
SQP	-	0,00E+00	1,19E+02	4,72E+02
ODP	kg CFC11-eq.	0,00E+00	2,02E-06	8,60E-07
POCP	kg NMVOC eq.	0,00E+00	5,88E-02	3,08E-02
ADP-f	MJ	0,00E+00	1,38E+02	2,78E+02
ADP-mm	kg Sb-eq.	0,00E+00	2,31E-04	8,72E-05
WDP	m3 World eq. withdrawn	0,00E+00	4,93E-01	4,73E+00

AP = Acidification potential, accumulated exceedance; GWP-total = Global warming potential, total; GWP-b = Global warming potential, biogenic; GWP-f = Global warming potential, fossil; GWP-luluc = Global warming potential, land use and land use change; ETP-fw = Ecotoxicity potential, freshwater; PM = Particulate matter emissions disease potential; EP-m = Eutrophication potential, fraction of nutrients reaching marine saltwater end compartment; EP-fw = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-t = Eutrophication potential, accumulated potential; HTP-c = Human toxicity potential, cancer effects; HTP-nc = Human toxicity potential, non-cancer effects; IRP = Ionizing radiation potential, human health; SQP = Soil quality potential; ODP = Depletion potential of the stratospheric ozone layer; POCP = Formation potential of tropospheric ozone; ADP-f = Abiotic depletion potential for fossil resources; ADP-mm = Abiotic depletion potential for non-fossil resources, minerals and metals; WDP = Water deprivation potential, deprivation-weighted water consumption

Table 3: LCA results - resource consumption, output streams & waste categories: 1 t Crane® Spheres 20

Parameter	Unit	A1	A2	A3
PERE	MJ	0,00E+00	1,72E+00	1,01E+02
PERM	MJ	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	0,00E+00	1,72E+00	1,01E+02
PENRE	MJ	0,00E+00	1,46E+02	2,58E+02
PENRM	MJ	0,00E+00	0,00E+00	3,98E+01
PENRT	MJ	0,00E+00	1,46E+02	2,98E+02
SM	kg	1,41E+03	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00
FW	m3	0,00E+00	1,68E-02	1,88E-01
HWD	kg	0,00E+00	3,49E-04	1,15E-04
NHWD	kg	0,00E+00	8,74E+00	1,19E+00
RWD	kg	0,00E+00	9,05E-04	1,01E-03
CRU	kg	0,00E+00	0,00E+00	0,00E+00
MFR	kg	0,00E+00	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00
EET	MJ	0,00E+00	0,00E+00	0,00E+00
EEE	MJ	0,00E+00	0,00E+00	0,00E+00

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; 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; EET = Exported energy, thermic; EEE = Exported energy, electric

6. LCA: Interpretation

For easier understanding, the results are presented graphically in order to be able to see correlations and connections between the data more clearly.

In Figure 1 the shares of the different product life phases in the environmental impacts for Crane® Spheres 20 are shown.

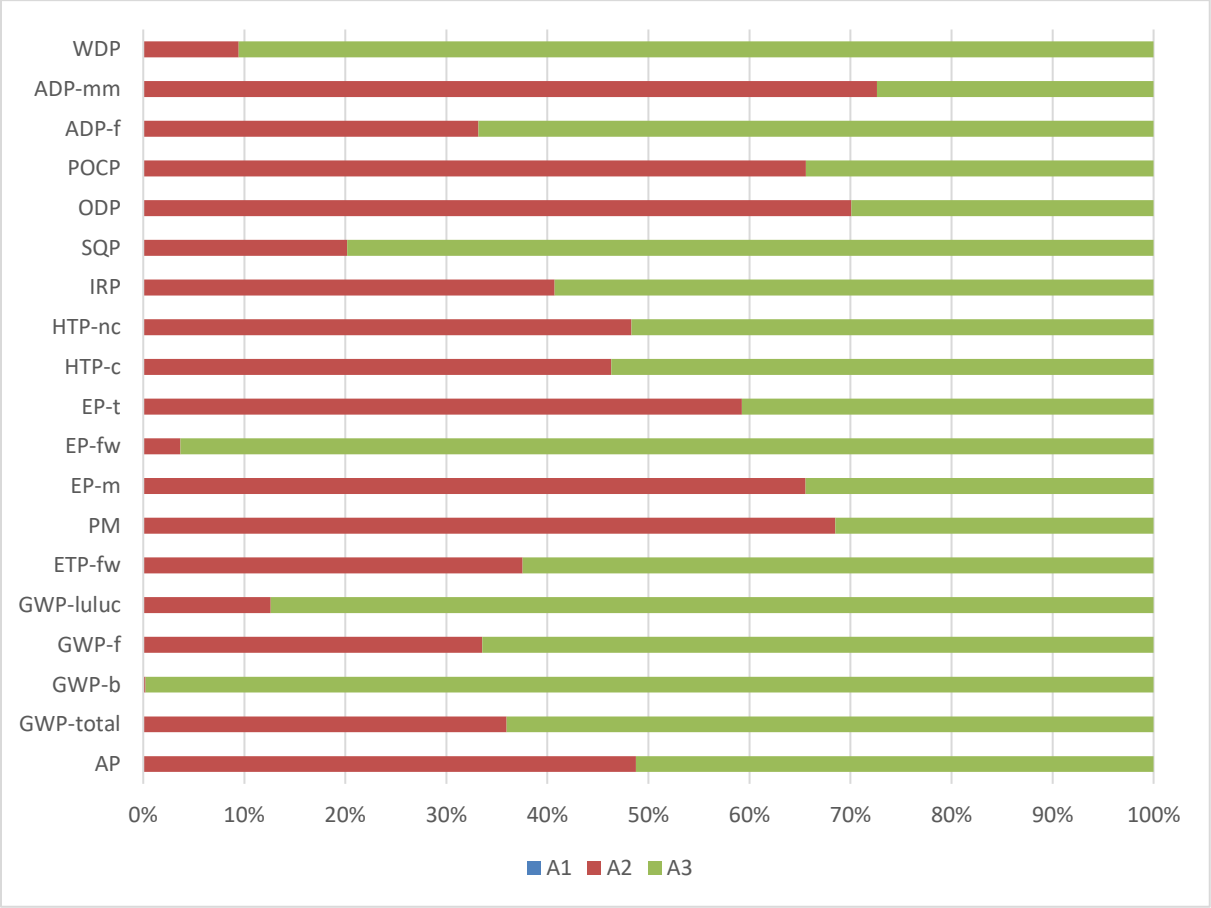


Figure 1: Shares of the product life phases in the environmental impacts for Crane® Spheres 20

Since the raw material for fly ash production is considered a waste product in the life cycle assessment, no environmental impacts are assigned to it. Thus, the share of raw material supply A1, as can be seen in the figures, is 0 % for all environmental impacts. Only the weight of the raw material plays a role in transport A2.

As can be seen in the figures, the shares of A2 and A3 vary greatly between the different environmental impacts. On average, A2 has a share of 47 % and A3 a share of 53 %.

7. Literature

Ecoinvent, 2019 Ecoinvent database version 3.6, 2019

EN 15804:	EN 15804:2012+A2:2019: Sustainability of construction works - Environmental product declarations - Basic rules for the product category construction products
EN 450-1:	Fly ash for concrete - Part 1: Definition, requirements and conformity criteria
ISO 14025:	DIN EN ISO 14025:2011-10: Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 14040:	DIN EN ISO 14040:2006-10, Environmental management - Life cycle assessment - Principles and framework; EN ISO 14040:2006
ISO 14044:	DIN EN ISO 14044:2006-10, Environmental management - Life cycle assessment - Requirements and guidelines; EN ISO 14040:2006
PCR A:	General product category rules for building products from the EPD programme of Ecobility Experts GmbH: Calculation rules for the LCA and requirements for the background report
PCR B:	Product category rules for fly ash from the EPD programme of Ecobili-ty Experts GmbH: Requirements for environmental product declarations for fly ash
R< THiNK, 2021	R< THiNK; online EPD tool from Nibe; 2021

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