Łukasiewicz
Instytut Ceramiki
i Materiałów Budowlanych

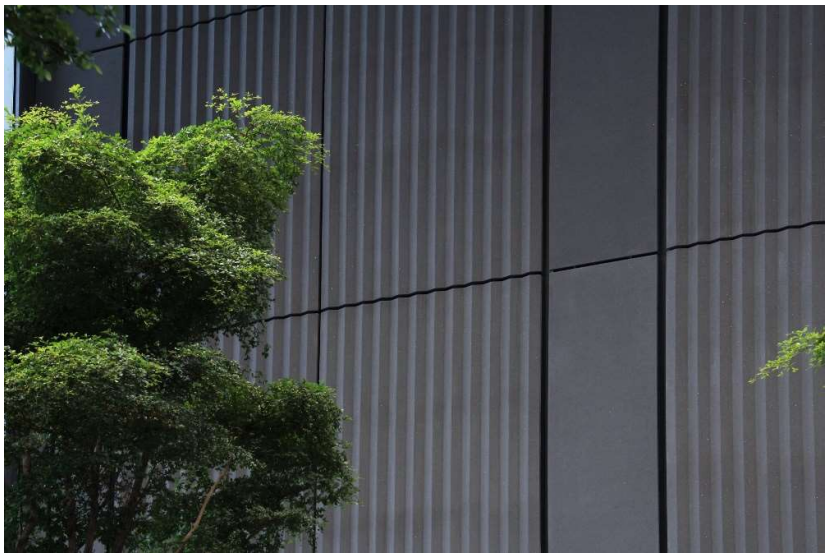
KROE

ENVIRONMENTAL PRODUCT DECLARATION

Nr 01-05/2023

GRC ELEMENTS

KROE Sp. z o.o.



Owner of the EPD:	*Kroe Sp. z o.o.*
Programme owner:	*Łukasiewicz Research Network – Institute of Ceramics and Building Materials*
Name of programme:	*Deklaracje Środowiskowe Produktów – B2B*
Issued:	***12.05.2023***
Valid until:	***12.05.2028***

Łukasiewicz
Instytut Ceramiki
i Materiałów Budowlanych

ENVIRONMENTAL PRODUCT DECLARATION
Nr 01-05/2023

KROE

1. GENERAL INFORMATION

Owner of the EPD: Kroe Sp. z o.o.	**Products covered by the EPD:** GRC elements on white cement GRC elements on grey low-emission cement
Programme owner: Łukasiewicz Research Network – Institute of Ceramics and Building Materials **http://www.icimb.pl/opole/**	**Owner of the EPD:** Kroe Sp. z o.o. 40 Żwirowa str. 32-050 Skawina Telephone: +48 12 350 57 63 e-mail: info@kroe.eu **https://www.kroe.eu/**
Date of issuance: 12.05.2023	**Declared product/declared unit:** The declared unit (DU) for the products is 1 kg (1 kilogram) GRC elements on white cement and GRC elements on grey low-emission cement
EPD valid until: 12.05.2028	**Scope:** The declaration covers the following products: **GRC elements on white cements, GRC elements on grey low-emission cement** manufactured in the Kroe Sp. z o.o.; 40 Żwirowa str, 32-050 Skawina. It contains information about the impact of the declared products on the environment. All data on the production cycle have been collected by Kroe Sp. z o.o. from December 1, 2021 to November 30, 2021 (12 months) and corresponded to the productions technology of that time. All data are averaged for total production of GRC elements on white cements and GRC elements on grey low-emission cement produced by Kroe Sp. z o.o. in Skawina. The life cycle assessment has been developed in accordance with the requirements of PN-EN ISO 15804+A2:2020, PN-EN ISO 14025 and PN-EN ISO 14040. The rules for product categorization have been adopted in accordance with the PN-EN 15804 standard. The declaration owner is responsible for the underlying information and evidence. Łukasiewicz Research Network – Institute of Ceramics and Building Materials Environmental Engineering Center in Opole is not responsible for the manufacturer's information and data and evidence regarding the life cycle assessment. Declarations resulting from different programs or performed not in accordance with the standard may not be compared.

Łukasiewicz
Instytut Ceramiki
i Materiałów Budowlanych

ENVIRONMENTAL PRODUCT DECLARATION
Nr 01-05/2023

KROE

Product Category Rules (PCR)	According to: PN-EN 15804+A2:2020-03 Sustainability of construction works. Environmental product declarations. Basic principles of categorization of construction products.
Representativeness:	Polish product, year 2021/22
Reference Service Life (RSL):	50 years
Reasons for performing LCA:	B2B
Life cycle Analysis (LCA):	LCA covers modules A1-A3, C1-C4 and D according to PN-EN 15804+A2 standard (Cradle-to-Gate with options)

Łukasiewicz Research Network – Institute of Ceramics and Building Materials, Environmental Engineering Center provides access to the type III EPD for GRC elements by Kroe Sp. z o.o. to the interested parties.

Authors:

Katarzyna Kiprian, MSc Eng.
Ewa Głodek-Bucyk, PhD Eng.

Approved by:
Joanna Poluszyńska, PhD

Director of the environmental engineering center

Ewa Głodek-Bucyk, PhD Eng.

Leader of Process Engineering Research Group

Verification:

CEN PN-EN 15804+A2 standard serves as main PCR.
Independent EPD and data verification according to PN-EN ISO 14025:2010 standard.

☐ internal ☒ external

Katarzyna Grzesik, PhD Eng.

2. MANUFACTURER AND PRODUCT DESCRIPTION

The KROE Sp. z o. o. has been operating in the construction industry for more than 14 years. It specializes in production of thin-walled elements made of GRC. GRC material combines the advantages of fiberglass and concrete. The material is characterized by much better strength, durability and resistance to brittle fracture. Concrete GRC contains only mineral raw materials, it is an environmentally friendly, fully recyclable material. It can be easily molded, and its surface can be shaped into a variety of textures, patterns, including 3D ones. Concrete with fiberglass can be colored in the mass, so the color palette of this material is unlimited. KROE uses spray technology, which allows the glass fiber to be evenly distributed across the surface of the slab and its strategic areas, which improves bending strength.

Caring for the environment is one of the company's most important foundations. The company is ISO 14001, 9001 and GRCA certified. The quality of the products is confirmed by tests in accredited laboratories.

The company focuses on innovation, constantly looking for new ways of development and developing products in such a way that they best meet the needs of their users.

The group of products covered by the declaration are GRC element:

- GRC element on white cement
- GRC element on grey low-emission cement

The indicative composition of the products covered by the declaration is presented in the table below:

Material	Mass fraction [%]
Silica sand	40
Cement	40
Water	13
Fiberglass	5
Concrete admixtures and colorants	2

Both products are produced on the same production line according to the figure shown below:

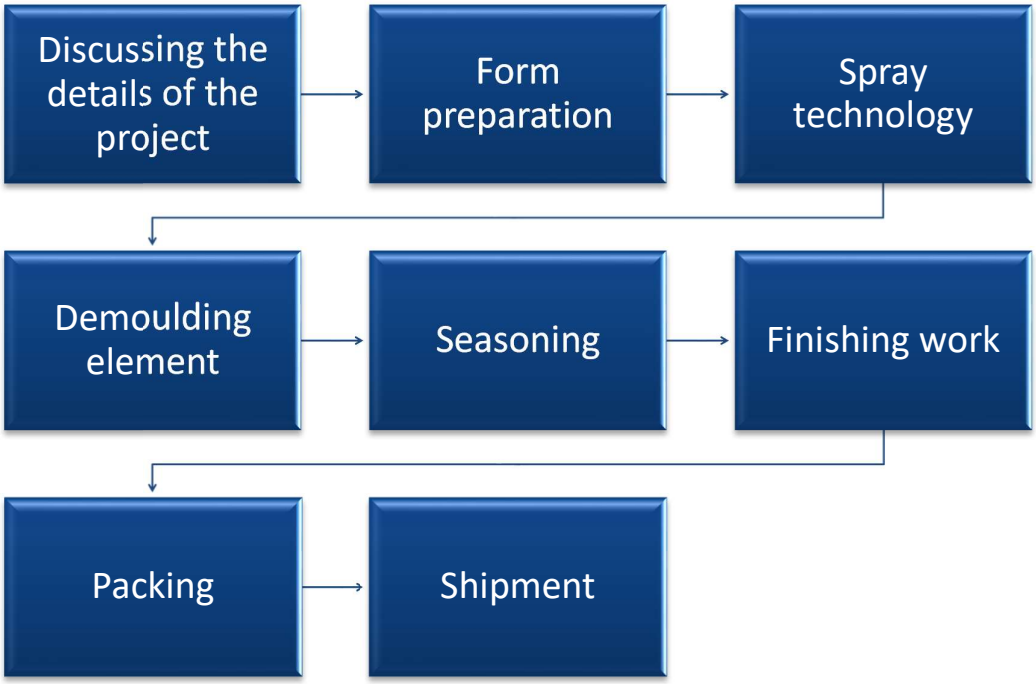


Figure 1: The production diagram GRC elements producing by Kroe Sp. z o.o.

GRC element on white cement by company Kroe Sp. z o.o. are using technology GRC/GFRC (glassfibre reinforced concrete) thin-walled technology. Elements are produced using the layered glassfibre spray technology.

According to the GRCA (The International Glassfibre Reinforced Concrete Association) classification, the products complay with class 18P, so they have a minimum bending strength of 18 Mpa (modulus of rapture)

GRC elements have a very wide range of applications, among which the most popular is by far their use as interior and exterior panels.

Technical Data – GRC element produced on white cement:

Characteristics	Value
Concrete class	C50/60
Alkali resistance fiberglass	Yes
Compressive strength of concrete	$> \mathbf{60}\ \mathrm{N/mm^2}$
Strength of bending MOR	$> \mathbf{18}\ \mathrm{N/mm^2}$
Durability	satisfactory
Waterproof	≥W8
Frost resistance	F100
Specific weight	$\mathbf{1800} - \mathbf{2100}\ \mathrm{kg/m^3}$
Young's modulus*	1100 $\mathrm{kN/cm^2}$
Kirchhoff's modulus*	1000 $\mathrm{kN/cm^2}$

GRC elements on grey low-emission cement are prefabricated elements produced on the basis of grey cement in GRC/GFRC (glass fiber reinforced concrete) thin-walled technology. Fiberglass reinforcement is complies with spray technology.

The finished product meets the bending strength of at least 18 MPa, so according to the GRCA (The International Glass fiber Reinforced Concrete Association) classification, the produced elements comply to class 18P.

Due to their lightness, plasticity and universality, GRC panels are used as panels inside and outside. GRC elements have the natural color of hardened concrete resulting from the natural raw material cement.

Technical Data – element GRC produced on grey low-emission cement:

Characteristics	Value
Concrete class	C50/60
Alkali resistance fiberglass	Yes
Compressive strength of concrete	$> \mathbf{60}\ \mathrm{N/mm^2}$
Strength of bending MOR	$> \mathbf{18}\ \mathrm{N/mm^2}$
Durability	satisfactory
Waterproof	≥W8
Frost resistance	F100
Specific weight	$\mathbf{1800} - \mathbf{2100}\ \mathrm{kg/m^3}$
Young's modulus*	1100 $\mathrm{kN/cm^2}$
Kirchhoff's modulus*	1000 $\mathrm{kN/cm^2}$

3. LCA: CACULATION RULES

System boundaries

The life cycle analysis of the tested products includes A1-A3, C1-C4 and D (Cradle to Gate with options) modules in accordance with PN-EN 15804. It includes the following modules:

- A1 – extraction and preparation of raw materials, generation of electricity and Energy carriers for auxiliary processes,
- A2 – transport raw materials to the gate of the production plant,
- A3 – production, including ancillary processes and emissions,
- C1 – deconstruction/demolition,
- C2 – transport to the waste processing facility,
- C3 – processing of waste material,
- C4 – treatment of waste material,
- D – re-use potential.

Data collection period

Data on the production process was collected in the years 2021-2022 (in the period 01/12/21 to 30/11/22).

Declared unit (DU)

Due to negligible differences between the two groups of products, the declared unit of 1 kg GRC elements on white cement and GRC elements on grey low-emission cement produced by Kroe Sp. z o.o. in Skawinie.

Assumptions

A1 – extraction and consumption of raw materials refers to specific mass shares in the production process per declared unit of the product.

A2 – distances from the place of obtaining raw materials to the production plant individual for each raw material, means of transport differentiated due to the method of raw materials delivery.

A3 – values of CO_2, NO_x, SO_2, dust and other emissions from the production process obtained as a result of measurements carried out at the plant, other estimated on the basis of fuel consumption.

C1 – module C1 describes the dismantling/demolition of the material. Data is collected based on the developed scenario. At the demolition site, the initial sorting of the material takes place. The dismantling of GRC elements does not require energy and material expenditures, and it is possible to dismantle manually or with power tools. The impact of these operations is so small that the environmental impact of the C1 module is neglected.

C2 – module C2 assumed that pre-sorted waste from demolition GRC elements are always transported to a waste recovery or disposal facility. Data is collected on the basis of a develop.

C3 – module C3 takes into account the environmental impact of processing construction and demolition waste containing joint compound in a waste recovery facility.

Data is collected on the basis of a developed scenario.

C4 – module C4 should take into account the impact of stored construction rubble containing GRC elements. In the developed scenario, land fill operations are not taken into account, because construction rubble is not worthless waste, it is recyclable and should not end up in municipal waste landfills.

D – module D provides information on the impact and effects of using recycled material. Assumed was thermal utilization of packaging material. Calculation are made on the basis of a developed scenario.

Cut-off criteria

99% of all mass flows involved in the production process were taken into account.
All the energy used in the process has been taken into account in the EPD.

General data

The main source of general and auxiliary data is the EcoInvent 3.8 database and manufacturer's reports.

Allocation

All data provided by the manufacturer have been referred to the declared unit (DU) of the product – 1 kg of the GRC elements produced by company Kroe Sp. z o.o. in Skawinie.

4. LCA: SCENARIOS AND ADDITIONAL TECHNICAL DATA

For the life cycle analysis of the products covered by the "Cradle to gate with options" environmental declaration, scenarios were developed for modules C2 and C3:

Module C2:

In order to calculate the impact of this module, the following assumptions were made:

- 100% GRC elements is transported to a recovery plant as part of waste 17 01 01 or 17 01 02 (construction rubble),
- Transport is carried out using self-unloading trucks with a load capacity 7.5 - 16 tons, meeting EURO 6 emission standards
- The materials is transported to a waste treatment site 100 km from the demolition site.

Module C3:

Waste containing GRC elements intended for recovery is classified as "non-hazardous waste" with code 17 01 01 or 17 01 02. The recycling process includes crushing and screening. There is no pre-treatment, additional fraction screening or post treatment. Recycling takes place at the waste treatment plant. Only coarse crushing is used to obtain the appropriate classification.
Group of waste (17 01 02) is usually recovered during backfilling. Electricity consumption per 1 kg of waste is 0.03 kWh/kg, and energy for internal transport vehicles is 0.3 MJ.

5. LCA: RESULTS

The table below shows the LCA modules included in the calculation of the environmental impact categories for the products covered by the declaration.

SYSTEM BOUNDARIES (X –MODULE INCLUDED IN LCA, MND – MODULE NOT DECLARED)																
Products stage			**Construction process stage**		**Use stage**							**End-of-life stage**				**Benefits and loads beyond the system boundary**
Raw material supply	Transport	Production	Transport	Construction process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction	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**	**MND**	**MND**	**MND**	**MND**	**MND**	**X**	**X**	**X**	**X**	**X**

The following tables present the results of the LCA analysis for GRC elements on white cement, GRC elements on gray low-emission cement. Explanations of the abbreviations used to describe the impact categories are given below:

GWP-total	Global warming potential
GWP-fossil	Global warming potential fossil fuel
GWP-biogenic	Global warming potential biogenic
GWP-luluc	Global warming potential land use and land change
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential of land and water
EP-freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication potential, fraction of nutrients reaching marine end compartment
EP-terrestial	Eutrophication potential, Accumulated Exceedance
POCP	Formation potential of tropospheric ozone photochemical oxidants
ADP-minerals&metals	Abiotic depletion potential for nonfossil resources
ADP-fossil	Abiotic depletion potential for fossil resources
WDP	Water (user) deprivation potential
PM	Potential incidence of disease due to PM emissions
IRP	Potential Human exposure efficiency relative to U235

ETP-fw	Potential comparative Toxic Unit for ecosystems
HTP-c	Potential comparative Toxic Unit for humans (cancerogenic)
HTP-nc	Potential comparative Toxic Unit for humans (non-cancerogenic)
SQP	Potential soil quality index
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
PEN-RE	Use of non-renewable primary energy resources excluding non-renewable primary energy resources used as raw materials
RE	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 fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water

CORE ENVIRONMENTAL IMPACT INDICATORS: 1 kg GRC element on white cement									
	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO2 eq.	5,39E-01	9,84E-02	1,54E-01	0,00E+00	2,25E-02	6,27E-02	0,00E+00	-1,93E-03
GWP-fossil	kg CO2 eq.	5,69E-01	9,83E-02	1,54E-01	0,00E+00	2,25E-02	6,25E-02	0,00E+00	-1,93E-03
GWP-biogenic	kg CO2 eq.	-1,05E-01	5,16E-05	5,98E-04	0,00E+00	1,95E-05	1,37E-04	0,00E+00	2,78E-07
GWP-luluc	kg CO2 eq.	2,72E-04	4,36E-05	5,29E-05	0,00E+00	1,06E-05	1,07E-05	0,00E+00	-6,25E-07
ODP	kg CFC11 eq.	3,17E-08	2,24E-08	3,45E-08	0,00E+00	5,07E-09	6,84E-09	0,00E+00	-3,59E-10
AP	mol H+ eq.	3,01E-03	3,29E-04	1,22E-03	0,00E+00	6,37E-05	5,49E-04	0,00E+00	-4,26E-05
EP-freshwater	kg PO4 eq.	1,44E-05	8,23E-07	1,77E-05	0,00E+00	1,84E-07	4,47E-06	0,00E+00	-1,41E-08
EP-marine	kg N eq.	5,58E-04	7,55E-05	1,38E-04	0,00E+00	1,21E-05	1,63E-04	0,00E+00	-1,38E-05
EP-terrestrial	mol N eq.	5,87E-03	8,41E-04	1,55E-03	0,00E+00	1,35E-04	1,80E-03	0,00E+00	-2,06E-04
POCP	kg NMVOC eq.	1,55E-03	3,04E-04	4,82E-04	0,00E+00	5,20E-05	4,97E-04	0,00E+00	-4,05E-05
ADP-minerals & metals	kg Sb eq.	2,27E-05	5,60E-07	1,44E-06	0,00E+00	1,03E-07	1,19E-07	0,00E+00	-8,29E-09
ADP-fossil	MJ	4,56E+00	1,48E+00	3,40E+00	0,00E+00	3,37E-01	7,67E-01	0,00E+00	-2,39E-02
WDP	WDP (m3) world eq. deprived	1,60E-01	5,01E-03	2,69E-02	0,00E+00	1,12E-03	5,11E-03	0,00E+00	-7,21E-04

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 kg GRC element on white cement									
	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	1,81E-08	8,38E-09	3,33E-09	0,00E+00	1,53E-09	8,73E-09	0,00E+00	-7,05E-10
IRP	kBq U235 eq.	1,59E-02	6,49E-03	1,01E-02	0,00E+00	1,47E-03	2,14E-03	0,00E+00	-1,03E-04
ETP-fw	CTUe	1,44E-05	8,23E-07	1,77E-05	0,00E+00	1,84E-07	4,47E-06	0,00E+00	-1,41E-08
HTP-c	CTUh	4,81E-10	6,05E-11	6,84E-11	0,00E+00	9,93E-12	2,11E-11	0,00E+00	9,00E-12
HTP-nc	CTUh	2,14E-08	1,32E-09	2,86E-09	0,00E+00	2,66E-10	6,94E-10	0,00E+00	-2,35E-11
SQP	-	2,82E+00	9,74E-01	5,38E-01	0,00E+00	1,99E-01	1,20E-01	0,00E+00	-1,50E-02

PARAMETERS DESCRIBING RESOURCE: 1 kg GRC element on white cement									
	Life Cycle Stage								
Indicator	**Units**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	4,58E+00	1,54E+00	3,91E+00	0,00E+00	3,29E-01	8,60E-01	0,00E+00	-2,65E-02
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	4,58E+00	1,54E+00	3,91E+00	0,00E+00	3,29E-01	8,60E-01	0,00E+00	-2,65E-02
PEN-RE	MJ	5,59E-01	2,49E-02	5,15E-01	0,00E+00	5,72E-03	2,91E-02	0,00E+00	-7,70E-04
RE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	5,59E-01	2,49E-02	5,15E-01	0,00E+00	5,72E-03	2,91E-02	0,00E+00	-7,70E-04

SM	kg	0,00E+00	0,00E+00	2,85E-02	0,00E+00	0,00E+00	1,04E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,77E-01
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,37E-02
FW	m3	8,71E-01	3,65E-01	2,23E-01	0,00E+00	-1,57E-03	1,62E+00	0,00E+00	6,33E-02

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 kg GRC element on white cement

	Life Cycle Stage								
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Non-hazardous waste	kg	WN	WN	2,85E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Components for re-use	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for recycling	kg	WN	WN	2,85E-02	0,00E+00	0,00E+00	1,04E+00	0,00E+00	0,00E+00
Materials for energy recovery	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,64E-02
Exported energy	MJ/energy carrier	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,90E-01

CARBON ORGANIC	
Contents organic carbon in product (kg C_{org})	0,00E+00
Contents organic carbon in packaging (kg C_{org})	1,48E-02

CORE ENVIRMONMENTAL IMPACT INDICATORS: 1 kg GRC element on grey low-emission cement									
	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO2 eq.	3,34E-01	4,34E-02	1,54E-01	0,00E+00	6,98E-04	6,42E-02	0,00E+00	-1,83E-03
GWP-fossil	kg CO2 eq.	4,39E-01	4,33E-02	1,54E-01	0,00E+00	6,97E-04	6,41E-02	0,00E+00	-1,83E-03
GWP-biogenic	kg CO2 eq.	-1,05E-01	5,16E-05	5,98E-04	0,00E+00	6,36E-07	1,45E-04	0,00E+00	6,46E-07
GWP-luluc	kg CO2 eq.	2,69E-04	1,97E-05	5,29E-05	0,00E+00	3,30E-07	1,10E-05	0,00E+00	-6,13E-07
ODP	kg CFC11 eq.	2,24E-08	9,83E-09	3,45E-08	0,00E+00	1,57E-10	7,01E-09	0,00E+00	-3,45E-10
AP	mol H+ eq.	1,90E-03	1,50E-04	1,22E-03	0,00E+00	1,97E-06	5,62E-04	0,00E+00	-3,59E-05
EP-freshwater	kg PO4 eq.	9,35E-06	3,75E-07	1,77E-05	0,00E+00	5,70E-09	4,58E-06	0,00E+00	-1,36E-08
EP-marine	kg N eq.	4,30E-04	3,53E-05	1,38E-04	0,00E+00	3,76E-07	1,67E-04	0,00E+00	-1,06E-05
EP-terrestrial	mol N eq.	4,94E-03	3,93E-04	1,55E-03	0,00E+00	4,20E-06	1,85E-03	0,00E+00	-1,69E-04
POCP	kg NMVOC eq.	1,30E-03	1,40E-04	4,82E-04	0,00E+00	1,61E-06	5,09E-04	0,00E+00	-3,08E-05
ADP-minerals & metals	kg Sb eq.	3,01E-06	2,68E-07	1,44E-06	0,00E+00	3,19E-09	1,22E-07	0,00E+00	-8,07E-09
ADP-fossil	MJ	3,51E+00	6,54E-01	3,40E+00	0,00E+00	1,04E-02	7,85E-01	0,00E+00	-2,24E-02
WDP	WDP (m3) world eq. deprived	9,53E-02	2,26E-03	2,69E-02	0,00E+00	3,47E-05	5,24E-03	0,00E+00	-1,09E-03

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 kg GRC element on grey low-emission cement									
	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	1,55E-08	3,75E-09	3,33E-09	0,00E+00	4,74E-11	8,95E-09	0,00E+00	-6,53E-10
IRP	kBq U235 eq.	1,20E-02	2,86E-03	1,01E-02	0,00E+00	4,54E-05	2,19E-03	0,00E+00	-1,02E-04
ETP-fw	CTUe	9,35E-06	3,75E-07	1,77E-05	0,00E+00	8,53E-03	7,01E-01	0,00E+00	-2,22E+00
HTP-c	CTUh	2,05E-10	2,89E-11	6,84E-11	0,00E+00	3,08E-13	2,17E-11	0,00E+00	1,58E-11
HTP-nc	CTUh	9,37E-09	5,94E-10	2,86E-09	0,00E+00	8,25E-12	7,11E-10	0,00E+00	-2,29E-11
SQP	-	5,18E+00	4,23E-01	5,38E-01	0,00E+00	6,18E-03	1,23E-01	0,00E+00	-1,50E-02

PARAMETERS DESCRIBING RESOURCE: 1 kg GRC element on grey low-emission cement									
	Life Cycle Stage								
Indicator	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	2,38E+00	6,37E-01	3,73E+00	0,00E+00	1,09E-02	9,22E-01	0,00E+00	-2,37E-02
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	2,38E+00	6,37E-01	3,73E+00	0,00E+00	1,09E-02	9,22E-01	0,00E+00	-2,37E-02
PEN-RE	MJ	7,78E-01	1,57E-04	3,83E-04	0,00E+00	2,23E-04	2,98E-02	0,00E+00	-7,53E-04
RE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

PENRT	MJ	7,78E-01	1,57E-04	3,83E-04	0,00E+00	2,23E-04	2,98E-02	0,00E+00	-7,53E-04
SM	kg	0,00E+00	0,00E+00	5,01E-02	0,00E+00	0,00E+00	1,06E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,73E-01
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,37E-02
FW	m3	9,01E-01	4,51E-02	3,80E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	7,05E-04

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 kg GRC element on grey low-emission cement

	Life Cycle Stage								
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Non-hazardous waste	kg	WN	WN	2,85E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Radioactive waste	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Components for re-use	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for recycling	kg	WN	WN	5,01E-02	0,00E+00	0,00E+00	1,06E+00	0 0,00E+00	0,00E+00
Materials for energy recovery	kg	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	6,16E-02
Exported energy	MJ/energy carrier	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	4,86E-01

CARBON ORGANIC	
Contents organic carbon in product (kg C_{org})	**0,00E+00**
Contents organic carbon in packaging (kg C_{org})	**1,35E-02**

6. INTERPRETATION OF LCA

Following figures 2 and 3 show the contributions of the each life cycle module to the basic impact categories for GRC elements on white cement and GRC elements on grey low-emission cement.

Fig. 2 Shares of life cycle modules on main categories of influence GRC elements on white cement

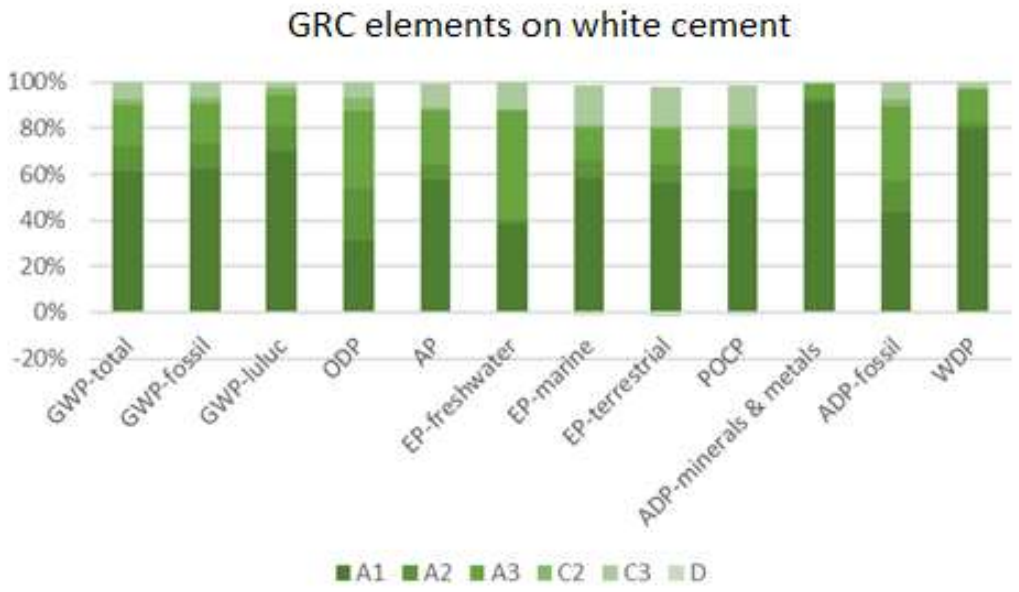
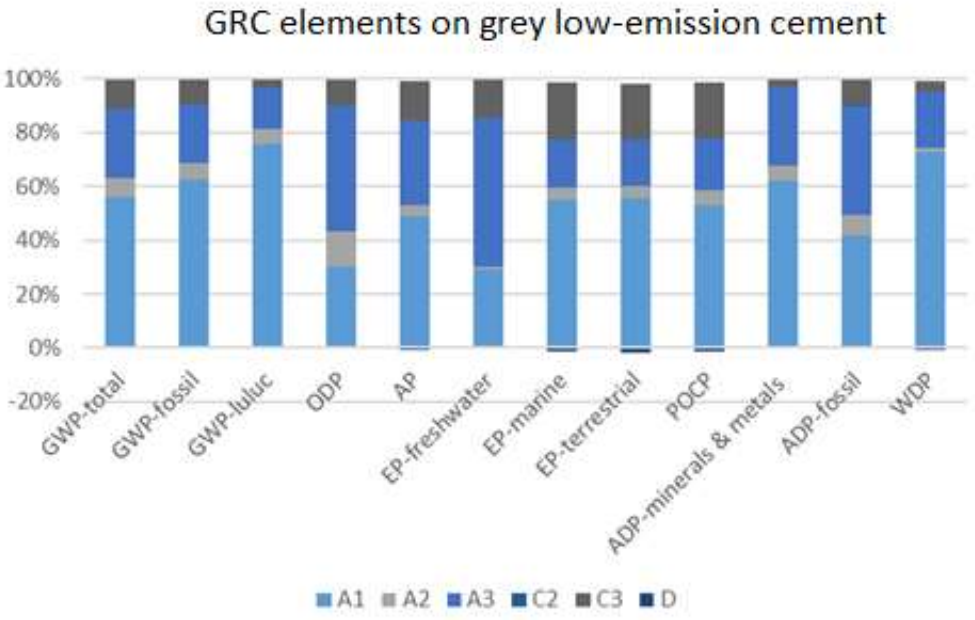


Fig. 3 Shares of life cycle modules on main categories of influence - GRC elements on grey low-emission cement



- The LCA analysis proved that the processes related to the acquisition of raw materials and semi-finished products (A1) have the greatest impact on the value of environmental impact indicators, however, the distribution between the modules of the production stage (A1-A3) is relatively homogeneous. Partial processes related to the acquisition of raw materials and energy affect the individual categories of impact to a different extent.

- The negative result in the criterion "characterization" for the category impact "cilmate change – biogenic" is mainly due to the fact that it takes into account the use of EUR pallets, for which, according to the database, the values of the category "cilmate change – biogenic" are negative, consequently, they also appear in the life cycle analysis (for products covered by the declaration).

- The impact of transport to the plant (A2) on the impact categories is little % of the total impact in the main categories.

- Transport to the waste treatment site (module C2) has relatively minor impact on the final values of the LCIA analysis.

- The waste processing process (construction rubble containing the products covered by the declaration) also does not significantly affect the final result.

- Taking into account the above conclusions, the owner of the declaration has a moderate influence on the values of the environmental impact indicators, because it depends on external entities. It can only try to change suppliers to ones that are closer to the production plant and reduce consumption at the level of the production process.

LITERATURE

- ✓ PN-EN ISO 14025:2014-04, Environmental labels and declarations – Type III environmental declarations – Rules and procedures.
- ✓ PN-EN 15804+A2:2020, Sustainability of construction works – Environmental product declarations – Basic rules for categorizing construction products.
- ✓ PN-EN ISO 14040:2009 Environmental management. Life Cycle Assessment. Principles and structure.
- ✓ PN-EN ISO 14044:2009, Environmental management. Life Cycle Assessment. Requirements and guidelines.
- ✓ EN 15942:2012, Sustainability of construction works – Environmental product declarations – Communication format business-to-business.
- ✓ Data from company website: https://www.kroe.eu/

Explanatory materials can be found on the manufacturers website: **https://www.kroe.eu/**

Łukasiewicz Research Network – Institute of Ceramics and Building Materials
31-983 Kraków, Cementowa 8 Str., Poland

CENTER OF ENVIROMENTAL ENGINEERING

Łukasiewicz
Institute
of Ceramics
and Building
Materials

45-641 Opole, Oświęcimska 21 Str., Poland
Phone: +48 77 456 32 01

www.icimb.lukasiewicz.gov.pl
info.opole@icimb.lukasiewicz.gov.pl

PROCESS ENGINEERING RESEARCH GROUP

TYPE III ENVIRONMENTAL DECLARATION CERTIFICATE

No. 01-05/2023

Products:

GRC ELEMENTS

GRC Element on white cement

GRC Element on grey low-emission cement

Owner:

KROE Sp. z o.o.
40 Żwirkowa Str.
32-050 Skawina

The declaration was developed in accordance with the requirements of the standard:

PN-EN 15804+A2: 2020-03

Sustainability of construction works
Environmental product declarations
Core rules for the product category of construction products

The declaration was verified in accordance with the requirements of the standard:

PN-EN ISO 14025:2010

Environmental labels and declarations
Type III environmental declarations. Principles and procedures

The certificate was issued for the first time on **May,12 2023** and is valid for 5 years or until the said EPD is amended.

Process Engineering Research Group Leader

Ewa Głodek-Bucyk, PhD Eng.

Director of Center Of Environmental Engineering

Joanna Poluszyńska, PhD

Opole, May 2023