ENVIRONMENTAL PRODUCT DECLARATION

Nr 01-11/2023

Fire-resistant glass

POLFLAM Sp. z o.o.

Owner of the EPD:	*POLFLAM Sp. z o.o.*
Programme owner:	*Łukasiewicz Research Network - Institute of Ceramics and Building Materials*
Name of programme:	*Environmental Product Declaration – B2B*
Issued:	***03.11.2023***
Valid until:	***03.11.2028***

Łukasiewicz
Instytut Ceramiki
i Materiałów Budowlanych

ENVIRONMENTAL PRODUCT DECLARATION
Nr 01-11/2023

POLFLAM®
FIRE RESISTANT GLASS

1. GENERAL INFORMATION

Owner of the EPD: POLFLAM Sp. z o.o.	**Products covered by the EPD:** Fire-resistant glass
Programme owner: Łukasiewicz Research Network – Institute of Ceramics and Building Materials **http://www.icimb.pl/opole/**	**Owner of the EPD:** POLFLAM Sp. z o.o. Jeziorzany, 3 Aleja Krakowska str 05-555 Tarczyn Telephone: +48 22 726 92 17 Email: info@polflam.pl **https://www.polflam.pl/**
Date of issuance: 03.11.2023	**Declared product/declared unit:** The declared unit (DU) for the products is 1 m^2 (square meters) fire-resistant glass POLFLAM EW, EI, BR i FR.
EPD valid until: 03.11.2028	**Scope:** The declaration covers the following products: **fire-resistant glass POLFLAM EW, EI, BR and FR** manufactured in the POLFLAM Sp. z o.o. Jeziorzany, 3 Aleja Krakowska str, 05-555 Tarczyn. It contains information about the impact of the declared products on the environment. All data on the production cycle have been collected by POLFLAM Sp. z o.o. from January 1,2022 to December 31, 2022 (12 months) and corresponded to the production's technology of that time. All data are averaged for total production of fire-resistant glass POLFLAM EW, EI, BR and FR produced by POLFLAM Sp. z o.o. in Jeziorzany. 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
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.

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FIRE RESISTANT GLASS

Representativeness:	Polish product, year 2022
Reference Service Life (RSL):	30 years
Reasons for performing LCA:	B2B
Life cycle Analysis (LCA):	LCA covers modules A1-A4, 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 fire-resistant glass produced by POLFLAM sp. z o.o. to the interested parties.

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Director of the environmental engineering center

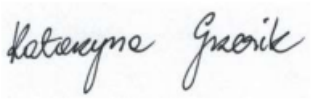
Ewa Głodek-Bucyk, PhD Eng.

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

POLFLAM has been in the glass industry since 1992, and has specialized in the production and sale of fire glass since 2005. We have gained a thorough knowledge of both fire glass and the structural systems in which it is used. We have to our credit hundreds of thousands of square meters of glass produced and thousands of realizations in Europe and around the world. Today POLFLAM is a completely independent manufacturer of fire glass: from technology through research - to production.

We offer the product together with a service system:

- laboratory facilities for testing glass and finished constructions,
- consulting and training.

The POLFLAM is a synonym for product quality and reliable and comprehensive service at every stage of the investment.The group of products covered by the declaration are fire-resistant glass:

- Fire-resistant glass EW
- Fire-resistant glass EI
- Fire-resistant glass BR
- Fire-resistant glass FR

The indicative composition of products covered by the declaration is presented in the table below. The percentage depends on the type of product.

Table 1 Indicative composition of the products covered by the declaration.

Material	Mass fraction [%]
Glass	50-80
Fire protection interlayer (Hydrogel)	20-40
Sealants	2-6
Spacer	2-6

POLFLAM fire-resistant glass production begins with the arrival of large-sized glass panes, which are then transferred to an automated warehouse connected to the horizontal cutting tables. The glass is cut to the required sizes and marked with a product and an unique ID code for traceability purposes and after that loaded onto an initial sorting system which organizes the material flow. Based on customer requirements, the glass then undergoes special edge treatment: seaming, grinding or polishing. The glass sheets are thoroughly cleaned in the washing machine and then transferred to the tempering furnaces.

After the tempering process, the glass panes re-enter the downstream sorting system, where they are waiting for an assembly process.

The assembly process begins with a vertical washing machine where the glass panes undergo a thorough cleaning process. Each pane undergoes careful inspection in a quality control scanner. Meanwhile, our dedicated team produces the necessary spacer bars for the assembly.

Once the quality control check is completed, the spacer bars are installed between the glass panes. Our assembly process involves combining two glass units separated by spacer bar, forming a cavity that is later filled with a hydrogel. The glass edge is precisely sealed with secondary sealant, ensuring maximum tightness of the cavity. After drying of the edge sealant the cavity is being filled with the hydrogel and then it undergoes the curing process, further enhancing the performance of POLFLAM glass.

Before being packed on stillages, each glass unit with applied product labels undergoes a final quality control in accordance with our stringent internal guidelines. This ensures that every glass unit meets our highest quality standards.

Finally, our finished glass unit is securely packed on either steel or wooden stillages and carefully wrapped with foil.

The safely packed glass units are then loaded onto trucks, ready for delivery to their final destination.

The products are produced on the same production line according to the scheme shown below:

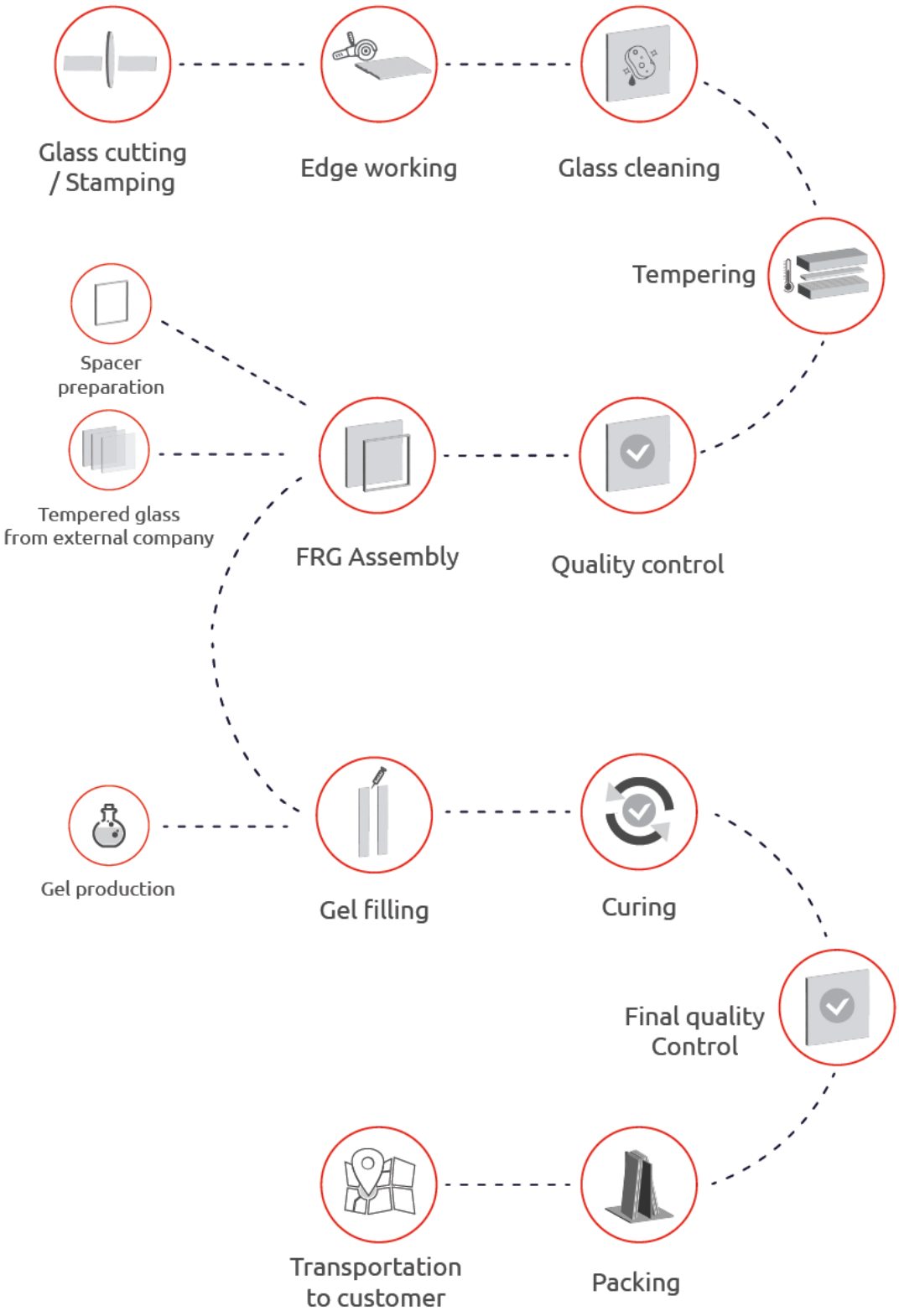


Fig. 1: The production diagram of fire-resistant glass by POLFLAM Sp. z o.o.

POLFLAM EI and POLFLAM EW are fully transparent fire-resistant glasses for various applications. POLFLAM EI fire-resistant glass meets integrity with full thermal insulation and POLFLAM EW fire-resistant glass meets integrity with reduced heat radiation. The two product families are based on the hydrogel technology developed by POLFLAM and meets requirements of EN 13501-2. Monolithic POLFLAM EI and POLFLAM EW fire-resistant glass consist of two thermally toughened safety glass panes according to EN 12150 with a minimum thickness of 5 mm, separated by a metal or composite spacer bar around the edges of the glass and a single cavity filled with a hydrogel interlayer with a minimal thickness of 6 mm. The spacer bar with applied Butyl on both sides as primary seal is positioned between the two glass panes and sealed around the perimeter with Polysulphide or Silicone as secondary seal. The hydrogel is produced at POLFLAM factory according to the company's own proprietary formula.

Monolithic POLFLAM EI and POLFLAM EW fire-resistant glass are designed for internal applications and as Insulated Glass Units for external building applications.

POLFLAM EI and POLFLAM EW fire-resistant glass are available in the fire-resistant classes according to EN 13501-2:

- EI 30 up to EI 180
- EW 30 up to EW 120

Construction of the fire-resistant glass is presented below:

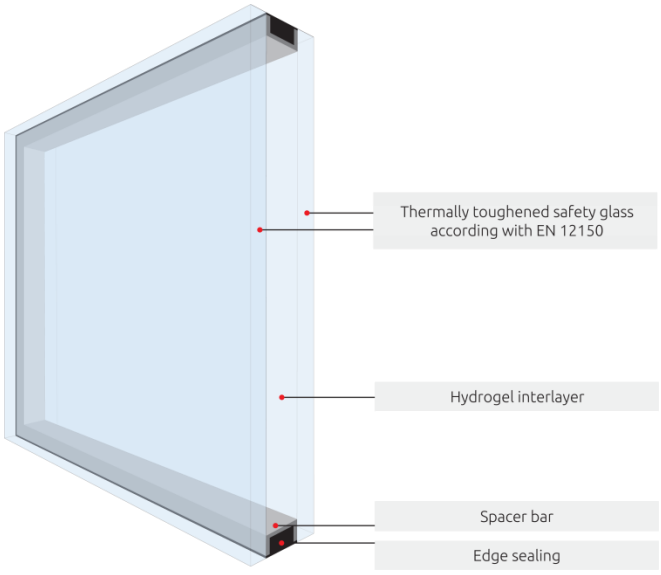


Fig. 2: Diagram of the construction of fire-resistant glass produced by POLFLAM Sp. z o.o

Monolithic POLFLAM fire-resistant glass EW, EI

Monolithic POLFLAM fire-resistant glass is used in internal partitions, windows, doors and facades.

Table 2 Technical data - monolithic fire-resistant glass POLFLAM EW, EI.

POLFLAM		EW 30	EW 60		EW 90	EW 120	EI 15	EI 30	EI 60		EI 90		EI 120		EI 180
Nominal thickness [mm]		16	16	20	16	16	16	20	25	28	32	35	35	40	55
Thickness tolerance [mm]		± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 2	± 3	± 3	± 3	± 3	± 3
Weight [kg/m²]		33	33	38	33	33	33	38	45	49	52	57	57	64	83
Fire resistance	EN 13501-2	EW 30	EW 60	EW 60	EW 90	EW 120	EI 15	EI 30	EI 60	EI 60	EI 90	EI 90	EI 120	EI 120	EI 180
Light transmittance τ_v [%]	EN 410	88*	88*	87	88*	88*	88*	87	87	87	85	87	87	86	85
Total solar energy transmittance g [%]	EN 410	73*	73*	72	73*	73*	73*	72	70	71	68	70	70	68	66
Thermal properties U_g [W/m²K]	EN 673	4.8*	4.8*	4.4	4.8*	4.8*	4.8*	4.4	4.0*	3.7	3.6*	3.3	3.3	3.0	NPD
Sound reduction index R_w (C; C_{tr})[dB]	EN 12758	41 (-2; -3)	41 (-2; -3)	42 (-2; -3)	41 (-2; -3)	41 (-2; -3)	41 (-2; -3)	42 (-2; -3)	44 (-2; -4)	45 (-1; -3)	44 (-2; -3)	47 (-1; -4)	47 (-1; -4)	48 (-1; -4)	45 (-1; -4)
Pendulum body impact resistance	EN 12600	1(B)1													
Reaction to fire	EN 13501-1	B-s1, d0													
Max. temperature range		-40 °C / +50 °C													
Curved glass		Yes													

*estimated values

POLFLAM BR fire-resistant glass

POLFLAM BR fire-resistant glass can be installed with the vertical sides of the glasses directly connected (butt-joint) to each other without the use of vertical posts or framing system.

Table 3 Technical data - monolithic fire-resistant glass POLFLAM BR.

POLFLAM BR		EI 30	EI 60		EI 90	EI 120
Nominal thickness [mm]		30	35	38	45	50
Thickness tolerance [mm]		± 2	± 3	± 3	± 3	± 3
Weight [kg/m²]		65	69	75	82	90
Fire resistance	EN 13501-2	EI 30	EI 60	EI 60	EI 90	EI 120
Light transmittance τ_v [%]	EN 410	84	84	84	84	84
Total solar energy transmittance g [%]	EN 410	68	67	67	64	66
Thermal properties U_g [W/m²K]	EN 673	4.6*	4.2*	3.6*	3.8*	2.9
Sound reduction index R_w (C; C_{tr})[dB]	EN 12758	44 (-2; -3)	44 (-2; -3)	44 (-1; -3)	47 (-2; -3)	46 (-1; -3)
Pendulum body impact resistance	EN 12600	1(B)1				
Reaction to fire	EN 13501-1	B-s1, d0				
Max. temperature range		-40 °C / +50 °C				
Curved glass		Yes				

*estimated values

POLFLAM FR fire-resistant glass

POLFLAM FR fire-resistant glass can be installed in the FR System allowing fire-resistant glass to be installed directly in openings of walls of various materials without the need for a commercial fire-resistant framing system.

Table 4 Technical Data - monolithic fire-resistant glass POLFLAM FR.

POLFLAM FR		EI 30	EI 60	EI 90	EI 120	EI 180
Nominal thickness [mm]		20	25	35	35	55
Thickness tolerance [mm]		± 2	± 3	± 3	± 3	± 3
Weight [kg/m²]		38	45	57	57	83
Fire resistance	EN 13501-2	EI 30	EI 60	EI 90	EI 120	EI 180
Light transmittance τ_v [%]	EN 410	87	87	87	87	85
Total solar energy transmittance g [%]	EN 410	72	70	70	70	66
Thermal properties U_g [W/m²K]	EN 673	4.4	4.0*	3.3	3.4*	NPD
Sound reduction index R_w (C; C_{tr})[dB]	EN 12758	42 (-2; -3)	44 (-2; -4)	47 (-1; -4)	45 (-1; -4)	45 (-1; -4)
Pendulum body impact resistance	EN 12600	1(B)1				
Reaction to fire	EN 13501-1	B-s1, d0				
Max. temperature range		-40 °C / +50 °C				
Curved glass		Yes				

*estimated values

3. LCA: CALCULATION RULES

System boundaries

The life cycle analysis of the tested products includes A1-A3, A4, 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,
- A4 – transport to the building site,
- 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 2022 (in the period 01.01.22 to 31.12.22).

Declared unit (DU)

Due to minor differences in the production process and characteristics of the products, the unit declared for the products covered by the Environmental Declaration is 1 m2 of EW, EI, BR and FR fire glass, produced at the POLFLAM Sp. z o.o. plant in Jeziorzany.

Assumptions

A1 – EXTRACTION AND CONSUMPTION of raw materials refers to specific mass shares in the production process, per unit of declared product.

A2 – TRANSPORT - 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 – PRODUCTION – EMISSION values of CO_2, NO_x, SO_2, dust from the production process obtained by estimation based on fuel consumption.

A4 - TRANSPORT of the final product to the construction site is treated as average weight values of transport to customers.

C1 – DEMOLITION, including disassembly or demolition of the product from the building, including initial sorting of materials on site - manual disassembly of the product at the end of its useful life is possible. The possible use of power tools for disassembly has a negligible impact on impact category values. Energy consumption in this module is so small that it has been ignored.

C2 – TRANSPORT is assumed that 100% of the waste constituting used fire-resistant glass is always transported to a waste recovery or disposal facility. Data is collected based on the developed scenario.

C3 – WASTE PROCESSING e.g. collection of waste fractions from demolition and processing of material streams for reuse, recycling and energy recovery. Calculations are made based on the developed scenario.

C4 – WASTE MANAGEMENT, takes into account the impact of landfilled waste (cullet). Data is collected based on the developed scenario.

D – RECYCLING POTENTIAL, addresses the impact and effects of using secondary material. Calculations are made based on the developed scenario.

Cut-of 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	Data for calculations come from Ecoinvent v. 3.9. and KOBIZE 2022. Emission factors for electricity were determined using actual KOBIZE 2022 data. A detailed analysis of data quality was part of the external audit.
Allocation	All data provided by the manufacturer have been referred to the declared unit (DU) of the product – 1 m^2 fire-resistant glass produced by POLFLAM Sp. z o.o. in Jeziorzany.

4. LCA: SCENERIOS AND ADDITIONAL TECHNICAL DATA

For the purpose of analyzing the life cycle of products covered by the environmental declaration in terms of "Cradle to gate with options", scenarios were developed for modules A4, and C1, C2, C3, C4 and D:

A4 module:

On the basis of the manufacturer's declaration, the following scenario was adopted Transport is carried out using trucks with a capacity of 16-32 tons meeting EURO 6 emission standards, average distance from the plant to the customer 350 km-data from the customer.

Module C1:

At the end of its useful life, the product is disassembled manually. The impact of this module can therefore be taken as zero.

Module C2:

Transport to the waste treatment site, the following assumptions were made to calculate the impact of this module:

- 100% of the waste constituting used fire glass is transported to a recovery facility. It is assumed that 70% of the fire glass is recycled and the remainder is stored.
- Transport is carried out by means of self-unloading vehicles with a capacity of 7.5 - 16 tons, meeting EURO 6 emission standards
- the material is transported to a waste processing site located within 100 km of the demolition site.

Module C3:

Waste processing, such as the collection of waste fractions from demolition and processing of material streams for reuse, recycling and energy recovery.

Processes assumed: unloading (loader), crushing (crusher).

For calculations assumed:

energy consumption	0,03	kWh/kg
fuel consumption	0,5	MJ/kg

Module C4:

In the developed scenario, it was assumed that 30% of the used fire-resistant glass is subjected to storage.

Module D

Reuse potential. For fire glass, it is assumed that 70% of the product is recycled.

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**	**X**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**X**	**X**	**X**	**X**	**X**

The following tables present the results of the LCA analysis for fire-resistant glass.

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

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ENVIRONMENTAL PRODUCT DECLARATION
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POLFLAM®
FIRE RESISTANT GLASS

CORE ENVIRMONMENTAL IMPACT INDICATORS: 1 m² POLFLAM 16-20 mm EI, EW, FR										
	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	4,42E+01	1,29E+00	1,88E+01	5,71E-02	0,00E+00	5,46E-01	1,28E+00	4,34E-02	-1,02E+00
GWP-fossil	kg CO_2 eq.	4,38E+01	1,29E+00	2,16E+01	5,70E-02	0,00E+00	5,45E-01	1,26E+00	4,32E-02	-8,91E-01
GWP-biogenic	kg CO_2 eq.	3,96E-01	1,11E-03	-2,89E+00	4,92E-05	0,00E+00	4,97E-04	2,02E-02	1,83E-04	-9,73E-02
GWP-luluc	kg CO_2 eq.	3,07E-02	5,16E-04	3,84E-02	2,28E-05	0,00E+00	2,58E-04	4,90E-04	9,71E-06	-3,84E-04
ODP	kg CFC11 eq.	5,01E-06	2,99E-07	4,52E-07	1,32E-08	0,00E+00	1,23E-07	1,82E-07	2,14E-08	-7,81E-08
AP	mol H+ eq.	4,25E-01	3,66E-03	9,63E-02	1,62E-04	0,00E+00	1,54E-03	1,06E-02	4,23E-04	-2,71E-03
EP-freshwater	kg PO_4 eq.	7,58E-03	8,45E-05	2,52E-02	3,74E-06	0,00E+00	4,11E-05	5,69E-04	2,46E-06	-2,97E-05
EP-marine	kg N eq.	6,73E-02	7,44E-04	1,79E-02	3,29E-05	0,00E+00	3,02E-04	4,18E-03	1,60E-04	-1,95E-03
EP-terrestrial	mol N eq.	8,03E-01	8,10E-03	1,45E-01	3,59E-04	0,00E+00	3,28E-03	4,47E-02	1,76E-03	-1,16E-02
POCP	kg NMVOC eq.	2,00E-01	3,12E-03	4,19E-02	1,38E-04	0,00E+00	1,26E-03	1,23E-02	5,02E-04	-5,36E-03
ADP-minerals & metals	kg Sb eq.	5,16E-04	4,57E-06	4,59E-05	2,02E-07	0,00E+00	2,50E-06	1,15E-06	8,42E-08	-1,02E-06
ADP-fossil	MJ	5,52E+02	1,95E+01	2,38E+02	8,64E-01	0,00E+00	8,17E+00	1,59E+01	1,40E+00	-5,58E+00
WDP	WDP (m^3) świat. ekw	1,60E+01	5,95E-02	2,95E+00	2,63E-03	0,00E+00	2,71E-02	3,97E-02	4,42E-03	-6,32E-02

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 m² POLFLAM 16-20 mm EI, EW, FR										
	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	4,28E-06	1,04E-07	2,65E-07	4,59E-09	0,00E+00	3,73E-08	2,35E-07	9,38E-09	-1,10E-07
IRP	kBq U235 eq.	2,67E+00	1,01E-01	3,99E-01	4,45E-03	0,00E+00	4,34E-02	5,57E-02	6,72E-03	-2,60E-02
ETP-fw	CTUe	7,58E-03	8,45E-05	2,52E-02	3,74E-06	0,00E+00	4,11E-05	5,69E-04	2,46E-06	-2,97E-05
HTP-c	CTUh	2,81E-08	4,93E-10	1,20E-08	2,18E-11	0,00E+00	2,41E-10	3,50E-10	1,77E-11	-2,09E-08
HTP-nc	CTUh	5,77E-07	1,55E-08	2,93E-07	6,85E-10	0,00E+00	6,45E-09	1,06E-08	3,66E-10	-4,04E-08
SQP	-	1,89E+02	1,36E+01	3,83E+02	6,02E-01	0,00E+00	4,83E+00	2,36E+00	3,11E+00	-1,01E+01

PARAMETERS DESCRIBING RESOURCE: 1 m² POLFLAM 16-20 mm EI, EW, FR										
	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	2,79E+01	2,80E-01	8,38E+01	1,24E-02	0,00E+00	1,38E-01	5,11E-01	2,84E-02	-8,46E-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	0,00E+00
PERT	MJ	2,79E+01	2,80E-01	8,38E+01	1,24E-02	0,00E+00	1,38E-01	5,11E-01	2,84E-02	-8,46E-02
PEN-RE	MJ	5,76E+02	2,03E+01	3,09E+02	8,99E-01	0,00E+00	8,48E+00	1,80E+01	1,45E+00	-5,87E+00
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	0,00E+00
PENRT	MJ	5,76E+02	2,03E+01	3,09E+02	8,99E-01	0,00E+00	8,48E+00	1,80E+01	1,45E+00	-5,87E+00
SM	kg	0,00E+00	0,00E+00	1,18E-01	0,00E+00	0,00E+00	0,00E+00	6,00E-01	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	0,00E+00	0,00E+00
NRSF	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	0,00E+00
FW	m^3	3,16E-01	3,12E-03	7,40E-01	1,38E-04	0,00E+00	1,64E-03	1,58E-02	4,85E-05	-5,68E-04

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m² POLFLAM 16-20 mm EI, EW, FR										
	Life Cycle Stage									
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**A4**	**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	0,00E+00

Non-hazardous waste	kg	WN	WN	1,46E-05	0,00E+00	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	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	0,00E+00
Materials for recycling	kg	WN	WN	1,18E-01	0,00E+00	0,00E+00	0,00E+00	1,51E+01	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	0,00E+00	0,00E+00
Exported energy	MJ/energy carrier	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CARBON ORGANIC	
Contents organic carbon in product (kg C_{org})	**0,00E+00**
Contents organic carbon in packaging (kg C_{org})	**5,81E-02**

CORE ENVIRMONMENTAL IMPACT INDICATORS: 1 m² POLFLAM 21-55 mm EI, EW, FR										
	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	5,20E+01	1,58E+00	1,83E+01	5,71E-02	0,00E+00	5,51E-01	1,30E+00	5,69E-02	-1,39E+00
GWP-fossil	kg CO_2 eq.	5,15E+01	1,58E+00	2,19E+01	5,70E-02	0,00E+00	5,50E-01	1,28E+00	5,66E-02	-1,33E+00
GWP-biogenic	kg CO_2 eq.	4,41E-01	1,36E-03	-3,74E+00	4,92E-05	0,00E+00	5,01E-04	2,05E-02	2,40E-04	-4,72E-02
GWP-luluc	kg CO_2 eq.	3,75E-02	6,31E-04	4,28E-02	2,28E-05	0,00E+00	2,60E-04	4,98E-04	1,27E-05	-6,78E-04
ODP	kg CFC11 eq.	5,91E-06	3,66E-07	4,86E-07	1,32E-08	0,00E+00	1,24E-07	1,85E-07	2,80E-08	-1,03E-07
AP	mol H+ eq.	4,76E-01	4,48E-03	9,79E-02	1,62E-04	0,00E+00	1,56E-03	1,08E-02	5,55E-04	-3,27E-03
EP-freshwater	kg PO_4 eq.	1,01E-02	1,03E-04	2,54E-02	3,74E-06	0,00E+00	4,15E-05	5,78E-04	3,23E-06	-4,47E-05
EP-marine	kg N eq.	7,51E-02	9,10E-04	1,83E-02	3,29E-05	0,00E+00	3,04E-04	4,25E-03	2,10E-04	-2,85E-03
EP-terrestrial	mol N eq.	8,90E-01	9,92E-03	1,49E-01	3,59E-04	0,00E+00	3,31E-03	4,54E-02	2,30E-03	-1,33E-02
POCP	kg NMVOC eq.	2,26E-01	3,81E-03	4,34E-02	1,38E-04	0,00E+00	1,27E-03	1,25E-02	6,59E-04	-4,58E-03
ADP-minerals & metals	kg Sb eq.	6,83E-04	5,60E-06	4,87E-05	2,02E-07	0,00E+00	2,52E-06	1,17E-06	1,10E-07	-1,41E-06
ADP-fossil	MJ	6,81E+02	2,39E+01	2,43E+02	8,64E-01	0,00E+00	8,24E+00	1,62E+01	1,83E+00	-7,55E+00
WDP	WDP (m^3) świat. ekw	2,19E+01	7,28E-02	3,38E+00	2,63E-03	0,00E+00	2,73E-02	4,04E-02	5,79E-03	-4,83E-02
ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 m² POLFLAM 21-55 mm EI, EW, FR										
	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PM	Disease incidency	4,72E-06	1,27E-07	2,86E-07	4,59E-09	0,00E+00	3,76E-08	2,39E-07	1,23E-08	-1,80E-07
IRP	kBq U235 eq.	3,30E+00	1,23E-01	4,40E-01	4,45E-03	0,00E+00	4,38E-02	5,66E-02	8,81E-03	-3,47E-02
ETP-fw	CTUe	1,01E-02	1,03E-04	2,54E-02	3,74E-06	0,00E+00	4,15E-05	5,78E-04	3,23E-06	-4,47E-05
HTP-c	CTUh	4,38E-08	6,04E-10	1,38E-08	2,18E-11	0,00E+00	2,43E-10	3,56E-10	2,32E-11	-8,20E-09
HTP-nc	CTUh	8,41E-07	1,90E-08	3,01E-07	6,85E-10	0,00E+00	6,50E-09	1,07E-08	4,80E-10	-2,48E-08
SQP	-	2,20E+02	1,67E+01	4,60E+02	6,02E-01	0,00E+00	4,87E+00	2,40E+00	4,07E+00	-1,13E+01
PARAMETERS DESCRIBING RESOURCE: 1 m² POLFLAM 21-55 mm EI, EW, FR										
	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**

PERE	MJ	3,50E+01	3,43E-01	9,81E+01	1,24E-02	0,00E+00	1,40E-01	5,20E-01	3,73E-02	-1,23E-01
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	0,00E+00
PERT	MJ	3,50E+01	3,43E-01	9,81E+01	1,24E-02	0,00E+00	1,40E-01	5,20E-01	3,73E-02	-1,23E-01
PEN-RE	MJ	7,11E+02	2,49E+01	3,14E+02	8,99E-01	0,00E+00	8,55E+00	1,63E+01	1,90E+00	-7,96E+00
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	0,00E+00
PENRT	MJ	7,11E+02	2,49E+01	3,14E+02	8,99E-01	0,00E+00	8,55E+00	1,63E+01	1,90E+00	-7,96E+00
SM	kg	0,00E+00	0,00E+00	1,34E-06	0,00E+00	0,00E+00	0,00E+00	6,00E-01	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	0,00E+00	4,18E-07
NRSF	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	0,00E+00
FW	m^3	1,96E-03	3,82E-03	7,49E-01	1,38E-04	0,00E+00	1,65E-03	1,61E-02	6,36E-05	-7,46E-04

ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m^2 POLFLAM 21-55 mm EI, EW, FR

	Life Cycle Stage								
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**A4**	**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	0,00E+00
Non-hazardous waste	kg	WN	WN	1,46E-05	0,00E+00	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	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	0,00E+00
Materials for recycling	kg	WN	WN	1,44E-01	0,00E+00	0,00E+00	0,00E+00	1,71E+01	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	0,00E+00	0,00E+00
Exported energy	MJ/energy carrier	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CARBON ORGANIC	
Contents organic carbon in product (kg C_{org})	**0,00E+00**
Contents organic carbon in packaging (kg C_{org})	**7,12E-02**

CORE ENVIRMONMENTAL IMPACT INDICATORS: 1 m^2 POLFLAM 30-45 mm BR

	Life Cycle Stage									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-total	kg CO_2 eq.	8,27E+01	2,32E+00	1,70E+01	5,71E-02	0,00E+00	1,08E+00	2,52E+00	7,47E-02	-1,75E+00
GWP-fossil	kg CO_2 eq.	8,18E+01	2,32E+00	2,29E+01	5,70E-02	0,00E+00	1,08E+00	2,48E+00	7,44E-02	-1,63E+00
GWP-biogenic	kg CO_2 eq.	7,63E-01	2,00E-03	-5,94E+00	4,92E-05	0,00E+00	9,81E-04	3,97E-02	3,15E-04	-9,47E-02
GWP-luluc	kg CO_2 eq.	5,65E-02	9,29E-04	7,86E-02	2,28E-05	0,00E+00	5,09E-04	9,66E-04	1,67E-05	-1,34E-03
ODP	kg CFC11 eq.	9,35E-06	5,38E-07	5,79E-07	1,32E-08	0,00E+00	2,43E-07	3,58E-07	3,68E-08	-2,01E-07
AP	mol H+ eq.	8,12E-01	6,60E-03	1,03E-01	1,62E-04	0,00E+00	3,05E-03	2,09E-02	7,30E-04	-5,90E-03
EP-freshwater	kg PO_4 eq.	1,34E-02	1,52E-04	2,58E-02	3,74E-06	0,00E+00	8,12E-05	1,12E-03	4,24E-06	-8,60E-05
EP-marine	kg N eq.	1,29E-01	1,34E-03	1,95E-02	3,29E-05	0,00E+00	5,95E-04	8,23E-03	2,76E-04	-3,55E-03

EP-terrestrial	mol N eq.	1,54E+00	1,46E-02	1,60E-01	3,59E-04	0,00E+00	6,48E-03	8,80E-02	3,03E-03	-2,35E-02
POCP	kg NMVOC eq.	3,82E-01	5,61E-03	4,77E-02	1,38E-04	0,00E+00	2,49E-03	2,42E-02	8,66E-04	-8,19E-03
ADP-minerals & metals	kg Sb eq.	9,12E-04	8,24E-06	5,65E-05	2,02E-07	0,00E+00	4,93E-06	2,27E-06	1,45E-07	-2,72E-06
ADP-fossil	MJ	1,01E+03	3,52E+01	2,57E+02	8,64E-01	0,00E+00	1,61E+01	3,13E+01	2,41E+00	-1,47E+01
WDP	WDP (m^3) świat. ekw	2,75E+01	1,07E-01	4,56E+00	2,63E-03	0,00E+00	5,35E-02	7,82E-02	7,61E-03	-5,49E-02
ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS: 1 m^2 POLFLAM 30-45 mm BR										
	Life Cycle Stage									
Indicator	**Unit**	8,22E-06	1,87E-07	3,45E-07	4,59E-09	0,00E+00	7,35E-08	4,63E-07	1,62E-08	-2,29E-07
PM	Disease incidency	4,91E+00	1,81E-01	5,52E-01	4,45E-03	0,00E+00	8,56E-02	1,10E-01	1,16E-02	-6,78E-02
IRP	kBq U235 eq.	1,34E-02	1,52E-04	2,58E-02	3,74E-06	0,00E+00	8,12E-05	1,12E-03	4,24E-06	-8,60E-05
ETP-fw	CTUe	4,63E-08	8,89E-10	1,84E-08	2,18E-11	0,00E+00	4,75E-10	6,89E-10	3,04E-11	-1,44E-08
HTP-c	CTUh	9,85E-07	2,79E-08	3,21E-07	6,85E-10	0,00E+00	1,27E-08	2,08E-08	6,31E-10	-3,93E-08
HTP-nc	CTUh	3,57E+02	2,45E+01	6,58E+02	6,02E-01	0,00E+00	9,53E+00	4,64E+00	5,35E+00	-2,21E+01
SQP	-	8,22E-06	1,87E-07	3,45E-07	4,59E-09	0,00E+00	7,35E-08	4,63E-07	1,62E-08	-2,29E-07
PARAMETERS DESCRIBING RESOURCE: 1 m^2 POLFLAM 30-45 mm BR										
	Life Cycle Stage a									
Indicator	**Unit**	**A1**	**A2**	**A3**	**A4**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	5,09E+01	5,05E-01	1,35E+02	1,24E-02	0,00E+00	2,73E-01	1,01E+00	4,90E-02	-2,36E-01
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	0,00E+00
PERT	MJ	5,09E+01	5,05E-01	1,35E+02	1,24E-02	0,00E+00	2,73E-01	1,01E+00	4,90E-02	-2,36E-01
PEN-RE	MJ	1,05E+03	4,54E+00	3,12E+02	8,48E-01	0,00E+00	1,57E+01	3,37E+01	2,36E+00	-1,43E+01
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	0,00E+00
PENRT	MJ	1,05E+03	4,54E+00	3,12E+02	8,48E-01	0,00E+00	1,57E+01	3,37E+01	2,36E+00	-1,43E+01
SM	kg	0,00E+00	0,00E+00	2,12E-01	0,00E+00	0,00E+00	0,00E+00	6,00E-01	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	0,00E+00	0,00E+00
NRSF	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	0,00E+00
FW	m^3	5,77E-01	5,62E-03	7,73E-01	1,38E-04	0,00E+00	3,23E-03	3,11E-02	8,35E-05	-1,44E-03
ENVIRONMENTAL INFORMATION DESCRIBING WASTE AND OUTPUT FLOWS: 1 m^2 POLFLAM 30-45 mm BR										
	Life Cycle Stage									
Indicator	**Unit (expressed per DU)**	**A1**	**A2**	**A3**	**A4**	**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	0,00E+00
Non-hazardous waste	kg	WN	WN	1,46E-05	0,00E+00	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	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	0,00E+00
Materials for recycling	kg	WN	WN	2,12E-01	0,00E+00	0,00E+00	0,00E+00	2,85E+01	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	0,00E+00	0,00E+00
Exported energy	MJ/energy carrier	WN	WN	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

CARBON ORGANIC	
Contents organic carbon in product (kg C_{org})	**0,00E+00**
Contents organic carbon in packaging (kg C_{org})	**1,05E-01**

6. INTERPRETATION OF LCA

Figures 3, 4, 5 show contributions of the each life cycle module to the basic impact categories for fire-resistant glass POLFLAM

Fig. 3 Shares of life cycle modules on main categories of influence - POLFLAM 16-20 mm EI, EW, FR.

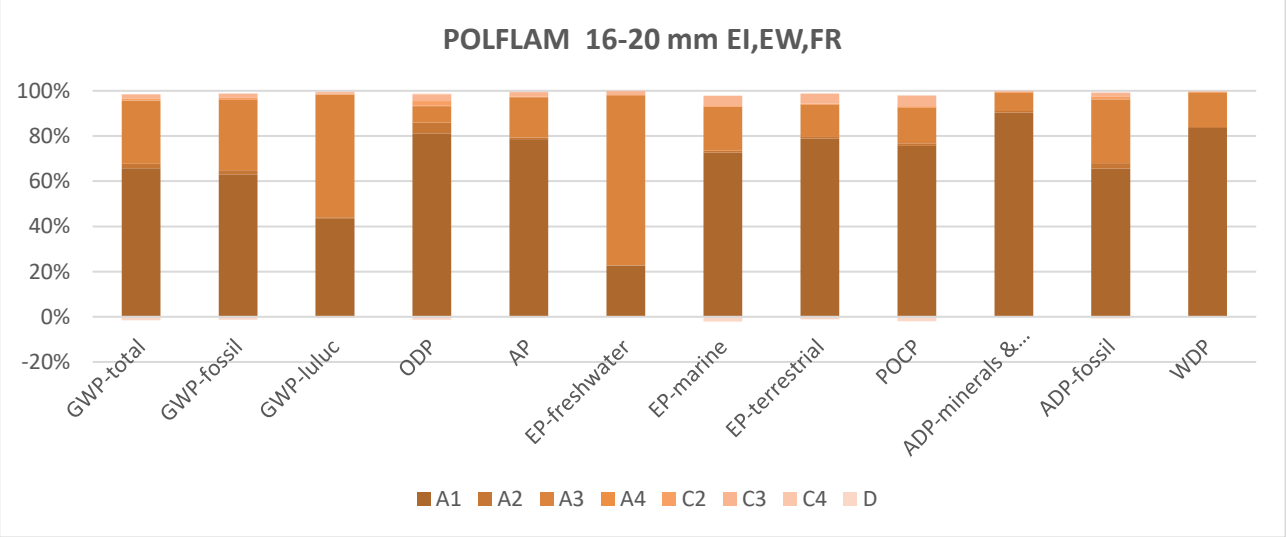


Fig. 4 Shares of life cycle modules on main categories of influence - POLFLAM 21-55 mm EI, EW, FR.

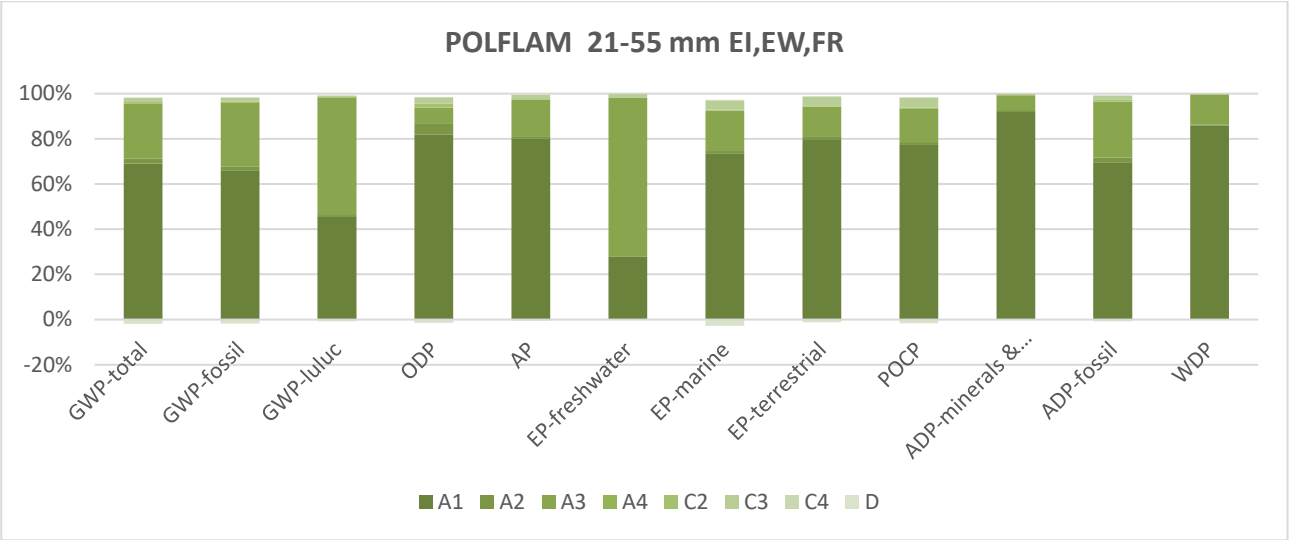
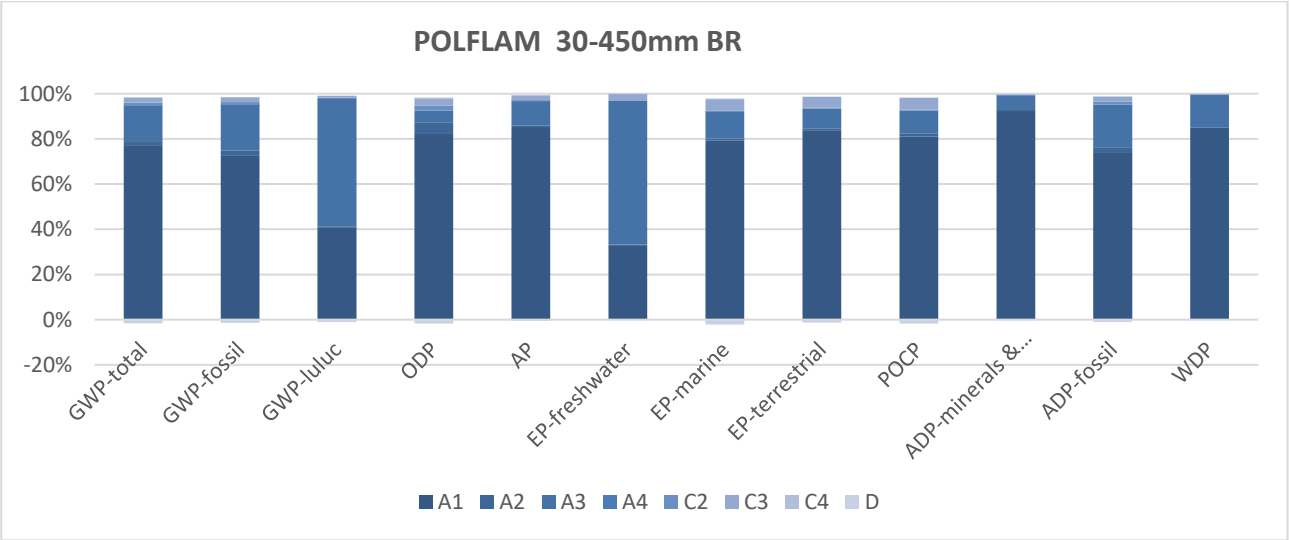


Fig. 5 Shares of life cycle modules on main categories of influence - POLFLAM 30-45 mm BR.



- The LCA analysis proved that the biggest impact on the value of the environmental impact indicators are processes related to the procurement of raw materials and intermediate products (A1). They account for about 80 to nearly 100% of the total value of the impact category. Sub-processes related to the acquisition of raw materials and energy affect the impact categories to varying degrees. The high values of the impact categories for these processes are due to the fact that the materials resulting from these processes have the largest mass share per declared unit. In addition, these processes are energy-intensive, requiring the provision of large amounts of heat and electricity (from non-renewable sources) and the acquisition of non-renewable raw materials.

- The negative result in the characterization criterion for the climate change - biogenic impact category is mainly due to the fact that racks made of wood are used, which has a negative CO^2 emission rate in its life cycle (not including disposal).

- Transportation to the waste treatment plant (C2) has a very small impact on the overall value of the impact category, amounting to a maximum of about 2% for the main impact categories.

- Waste treatment processes (C3) account for a maximum of up to 6% in the main impact categories. This depends on the amount of material to be processed and the technology at the waste processing plant.

- Given the aforementioned conclusions, the owner of the declaration has a moderate influence on the values of environmental impact indicators, as it depends on external parties. It can only try to change suppliers to those closer to the production site and reduce consumption at the production process level.

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.
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- ✓ Heinz Stichnothe1,2 and Adisa Azapagic1 Life cycle assessment of recycling PVC window frames Resources Conservation and Recycling · February 2013 DOI: 10.1016/j.resconrec.2012.12.005
- ✓ Additional explanatory material can be obtained from the owner of the declaration company website: http://www.polflam.pl/