Life Cycle Assessment

For Polyesh by Israbeton

Publication date: March 2024

In accordance with ISO 14040/44 and EN 15804+A2 the PCR of Construction Products.

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General Information

LCA Owner	Polybid Mishmar hanegev, Israel https://polybid.co.il/| marketing@polybid.co.il
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Independent verification of the declaration and data, according to ISO 14040/44 and EN15804+A2:2019.	
☒external	☐internal
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Declarations of LCA

The LCA owner has the sole ownership, liability, and responsibility for the LCA.

The LCA is based on the standard EN 15804+A2. LCAs of construction products may not be comparable if they do not comply with this standard. Only LCAs which are based on the PCR of construction products EN 15804+A2 and comply with the rules of this standard can be compared.

Product Information

Products included in this LCA:

- Polyesh- lightweight concrete boards with a polystyrene aggregate for insulation. The plates have low thermal conductivity and high fire resistance. It is applied to the internal and external surfaces of external walls, as well as to insulate cold bridges.

Name of Product	Material	Polyesh
Raw Materials	EPS	10-20%
	Cement- CEM II	50-70%
	Water	30-50%
	Additives	0-5%
Packaging Materials	Polyethylene cover	<0.1%
	Wood pallet	1.4%
Depth [cm]		2-7
Weight of product [kg]		Per 1 m^2 - 3-10.5
Dimensions [cm]		60x50, 60x150
UN CPC		369 – other plastics products

Specification:

Name of Product	Polyesh
Thermal Conductivity [W/m^2C°]	0.0572
Reaction to Fire Class	B
Compressive Stress at 10% Deformation	0.1 min
Color	Gray
Density [kg/m^3]	150

Conversion factors:

Polyesh concrete board have different densities, the relationship between the weight and environmental impact is linear, therefor the results can be converted by multiplying the environmental impact results (in tables in p. 10) by the factors in table below

Density [kg/m3]	Thermal Conductivity [W/m^2K°]	Conversion factor
120	0.0456	0.638
140	0.0513	0.837
150	0.0572	1.000
200	0.067	1.562

Life Cycle Assessment Calculation Rules

Declared Unit: The declared unit is 1 m^2 of Polyesh, r=1.

Type of LCA: Cradle-to-gate with modules C1- C4, D.

Declared Modules: A1-A3, C1-C4, D.

Goal and Scope: This LCA evaluates the environmental impacts of the production of 1 m^2 of Polybid's Polyesh concrete board from cradle to gate with modules C1- C4, D.

Reference Service Life (RSL): The Reference Service Lives of the product is at least 50 years.

Cut–off Criteria: All raw materials for the manufacturing of the declared concrete board, the required energy, water consumption and the resulting emissions are considered in the life cycle assessment. That way, components with a share of even less than 1% are included. All neglected processes contribute less than 1% to the total mass.

Allocations: Overall and in general, allocations were avoided whenever possible. Nevertheless, allocations were made in the general energy and water usage. Reuse, recycling and recovery allocations were not applied, but the recovery of EPS loss in the manufacturing process was taken into account.

Assumptions and Limitations:

- Approximated generic data has been used for additives which were not found in the Ecoinvent database, in addition to other databases and to research that was carried out.
- Generic data of larger areas have been used for some materials and processes inputs.
- Part of the raw material EPS data was modeled from an LCA supplied by the manufacturer.[1]
- The cement raw material was based on the environmental assessment results of the EPD of the purchased cement received from Polybid's supplier. The EPD validity has expired yet, it is the best data available and probably has more conservative figures.
- In cases of multiple suppliers for one raw material a proportional share was taken into account.
- The wooden pallets which are a part of the EPS board packaging are less than 5% of the total weight of the board including the package, and therefore the biogenic carbon content may be omitted, according to clause 6.4.4 of the PCR.
- Assumptions were made regarding the transportation for all materials required for manufacturing and packaging the product. Average data of the distance was included.
- The primary energy of raw materials was calculated for all renewable and non-renewable raw materials that had LHV value sources.

Geography: The study represents the manufacturing of the Polyesh in Polybid's manufacturing factory located in Idan HaNegev Industrial Park, Israel.

Time Representativeness: The data is representative for the year of 2023 and was collected for 10 months from January to October, due to the opening of a new facility.

Software: Simapro 9.4.0.3.

Foreground Data: The LCA is based on production data e.g., material flows and energy consumption, provided by Polybid.

Background Data: For modelling the LCA, Ecoinvent (v3.8-2021) and USLCI data (The Federal LCA Commons, U.S. Department of Agriculture) were used. Since there are hardly any datasets available for Israel, background data for larger area which Israel is included in was used for the life cycle inventory. For electricity data, an Israeli dataset was prepared according to the data of 2022 from the official report of the Israel electricity authority [1]. For water use data, an Israeli dataset was prepared according to the data of 2020 from the report of the National Water Institution of Israel [2].

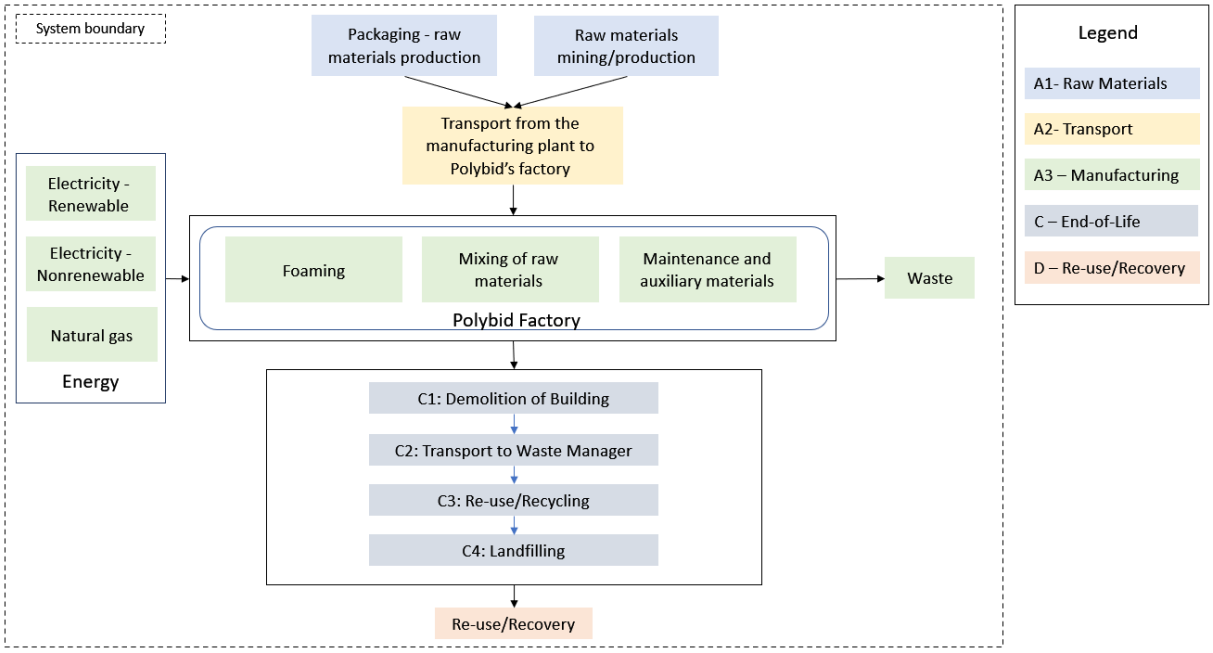
PCR: EN 15804+A2.

Impact Model Applied: EN 15804 + A2 method.

Standards Applied: ISO 14040/44.

System Boundaries

The general life cycle of concrete Boards is as shown in the following figure:



Life Cycle Modules (stages)

The modules chosen for the LCA (X - module included in LCA, MND - module not declared):

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	MND	MND	MND	MND	MND	X	X	X	X	X

Within this Life Cycle Assessment, the following processes are considered:

Product Stage (A1-A3):

Module A1 – Supply of raw materials: The declared concrete board consist of cement (CEM II), polystyrene, water and a small amount of additives. The raw materials supply includes raw material extraction/production that are taken into account in this study. The raw material of packaging, polyethylene and wood is also included in this module.

Module A2 – Transport of raw materials: The polystyrene is produced abroad in various countries in Asia and Europe. Accordingly, transport distances are varied and done by ships and trucks. Further raw materials are supplied from manufacturers within Israel**.**

Module A3 – Manufacturing: The manufacturing includes exposing the PS to steam, which causes the expansion of the polystyrene. The expanded polystyrene is then mixed with cement water and additives molded into blocks with various sizes. Electricity and natural gas are consumed during the manufacturing process, in addition to maintenance procedures.

End-of-Life stage (C1-C4):

Module C1 – De-construction: Demolition of the lightweight concrete boards takes place with the whole demolition of the building/construction. Thus, it is assumed that energy used for the demolition of the concrete boards has minor significance and the environmental impact of this module is set to be zero.

At the end-of-life, in the demolition phase 100% of the waste is assumed to be collected as mixed construction waste.

Module C2 – Transportation: Transportation distance to the closest disposal area is estimated as 50 km by a 16-32 tonne lorry, which is the most common.

Module C3 – Waste processing: According to interviews with industry executives that manage the construction waste in Israel (GREENMIX, Negevecology), and research on the waste sector in Israel, there is no any significant processing of the construction waste and especially not for the concrete boards, therefore the environmental impact of this module is set to be zero. There is processing of polystyrene packaging from municipal waste in an RDF facility, therefor there is a possibility for the conditions to change in the upcoming years.

Module C4 – Disposal: it is assumed and modeled that 100% of the concrete boards will be landfilled in the Israeli landfills of construction materials.

Resource Recovery stage (D):

Module D – Reuse-Recovery-Recycling potential: Module D is set to be zero since the is no reuse, recovery or recycling of the products.

Exclusion of Modules

Modules A4-A5, B1-B7 are not mandatory and excluded from this LCA according to the PCR of construction products EN 15804+A2.

Environmental Impacts

All characterization models, characterization factors and methods used are as defined in the PCR of construction products EN 15804+A2 Annex C Tables C.1-C.4.

The Environmental Impacts of the Polyesh

The Impact Assessment - for 1 m^2 of Polyesh, d=5.72 cm, 8.58 kg, 150 kg/m^3							
Impact Category	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Climate change - Fossil	kg CO2 eq	5.79E+00	0	6.99E-02	0	4.38E-02	0
Climate change - Biogenic	kg CO2 eq	-1.82E-01	0	6.03E-05	0	4.41E-05	0
Climate change - Land use and LU change	kg CO2 eq	5.18E-04	0	2.79E-05	0	4.24E-05	0
Climate change - Total	kg CO2 eq	5.61E+00	0	7.00E-02	0	4.39E-02	0
Ozone depletion	kg CFC11 eq	5.57E-08	0	1.62E-08	0	1.82E-08	0
Acidification	mol H+ eq	1.67E-02	0	1.98E-04	0	4.17E-04	0
Eutrophication, freshwater	kg P eq	1.43E-03	0	4.98E-07	0	4.12E-07	0
Eutrophication, marine	kg N eq	1.43E-03	0	3.94E-05	0	1.46E-04	0
Eutrophication, terrestrial	mol N eq	1.57E-02	0	4.39E-04	0	1.61E-03	0
Photochemical ozone formation	kg NMVOC eq	6.58E-03	0	1.69E-04	0	4.64E-04	0
Resource use, fossils	MJ	6.73E+01	0	1.06E+00	0	1.25E+00	0
Resource use, minerals and metals	kg Sb eq	7.30E-06	0	2.48E-07	0	1.02E-07	0
Water use	m3 depriv.	7.30E-01	0	3.22E-03	0	5.68E-02	0
Climate Change - GHG	kg CO2 eq	5.79E+00	0	6.99E-02	0	4.38E-02	0
Disclaimer 1	This impact category deals mainly with eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effect due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.						
Disclaimer 2	The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.						

Indicators Describing Resource Use – for 1 m^2 of Polyesh, d=5.72 cm, 8.58 kg, 150 kg/m^3							
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	4.73E+00	0	1.51E-02	0	9.93E-03	0
PERM	MJ	1.85E+00	0	0.00E+00	0	0.00E+00	0
PERT	MJ	6.58E+00	0	1.51E-02	0	9.93E-03	0
PENRE	MJ	4.63E+01	0	1.06E+00	0	1.25E+00	0

PENRM	MJ	2.11E+01	0	0.00E+00	0	0.00E+00	0
PENRT	MJ	6.73E+01	0	1.06E+00	0	1.25E+00	0
SM	kg	0.00E+00	0	0.00E+00	0	0.00E+00	0
RSF	MJ	0.00E+00	0	0.00E+00	0	0.00E+00	0
NRSF	MJ	0.00E+00	0	0.00E+00	0	0.00E+00	0
FW	m3	1.77E-02	0	1.20E-04	0	1.35E-03	0

Waste Categories and Output Flows – for 1 m^2 of Polyesh, d=5.72 cm, 8.58 kg, 150 kg/m^3							
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
HWD	kg	1.45E-04	0	2.76E-06	0	1.91E-06	0
NHWD	kg	1.64E-01	0	5.55E-02	0	8.58E+00	0
RWD	kg	2.46E-05	0	7.16E-06	0	8.25E-06	0
CRU	kg	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0

Abbreviations of Indicators

GWP-fossil	Global warming potential of fossil fuels
GWP-luluc	Global warming potential of land use and land use change
GWP-biogenic	Global warming potential of biogenic carbon
GWP-total	Global warming potential total
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential
EP-freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication potential, fraction of nutrients reaching marine end compartment
EP-terrestrial	Eutrophication potential of accumulated exceedance, the oversaturation of an eco-system with non-organic nutrients
POCP	Formation potential of tropospheric ozone photochemical oxidants
ADP –minerals & metals	Abiotic depletion potential for minerals and metals
ADP-fossil	Abiotic depletion potential for fossil resources
WDP	User deprivation potential, deprivation weighted water consumption
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	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	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
EEE	Exported electrical energy
EET	Exported thermal energy

External Critical Review

of an LCA report entitled: "Life Cycle Assessment of lightweight concrete board Polyesh"

Author of Critical Review Report

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The author of the LCA study reviewed

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SUMMARY AND RECOMMENDATION

The Life cycle assessment report "Life Cycle Assessment of EPS boards, Polyboard, Polyfloor, Polysilver" developed by Shai Ben Aharon and Eden Shukrun conforms to the ISO 14040 standard. Furthermore, the data collection and modelling methods are described clearly and correspond to the state of the art. Finally, the report is well-written, transparent, and consistent.

According to ISO 14040, the critical review process ensures that:

- The methods used in the LCA study are consistent with the international standard;
- The methods used in the LCA study are scientifically and technically valid;
- The data used are appropriate and reasonable concerning the goal of the study;
- The interpretations reflect the limitations identified and the goal of the study;
- The study report is transparent and consistent.

Several questions were asked about the study's implementation in the verification framework. All these questions were satisfactorily answered, and LCA models were demonstrated.

Prague, March 20th, 2024

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References

[1] "The electricty economy in Israel September 2023" by The Israel Electricity Authority.

[2] N. M. &. V. B. &. G. Thoma, "A national-level LCA of a water supply system in a Mediterranean semi-arid climate—Israel as a case study," 2020.

[3] T. S. S. Body, "EN 15804:2012+A2," UNE, Madrid, Spain, 2020.

[4] The PCR of EN 15804:2012+A2:2019/AC:2021.

[5] "ISO 14040," The Standards Institution of Israel, 2010.

[6] "ISO 14044," The International Organization for Standardization, 2006.

[7] Ecoinvent, "System Models," [Online]. Available: https://ecoinvent.org/the-ecoinvent-database/system-models/.

[8] ISO 14025:2010 Environmental labels and declarations – Type III environmental declarations principles and procedures.

[9] Ecoinvent database v3.8 (2021)

[10] Plastics euro, Eco-profile of grey and white Expandable Polystyrene (EPS), November 2022. https://plasticseurope.org/sustainability/circularity/life-cycle-thinking/eco-profiles-set/

[11] Polybid, Technical info, https://polybid.co.il/

[12] USLCI, The Federal LCA Commons, U.S. Department of Agriculture.

[13] Li Wanwei (2019), Styrene-acrylic emulsion, preparation method and application thereof, and latex paint coating. CN110982353A.

[14] Nesher, CEMII, EPD (2012).