ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	DURAVIT AG
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
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Acrylic bathtubs, shower trays and bath panels

DURAVIT AG

Institut Bauen und Umwelt e.V.

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1. General Information

DURAVIT AG

Acrylic bathtubs, shower trays and bath panels

Programme holder
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78132 Hornberg
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Declaration number
EPD-DUR-20210239-IBC1-EN

Declared product / declared unit
1 m² of acrylic surface of an average product including bathtubs, shower trays and acrylic panels.

This declaration is based on the product category rules:
Sanitary products made from composite materials, 12.2018 (PCR checked and approved by the SVR)

Scope:
This study is aimed to provide the life cycle impact assessment of Duravit sanitary acrylic products, including packaging, produced at Cairo plant in Egypt and distributed worldwide. The basis for the data collection is the year 2019. Due to the identical production method, the object of the EPD is the average acrylic production of the whole plant including bathtubs and shower trays, as well as acrylic panels, considering the total mass produced for the respective acrylic products for the reference year 2019. The system boundaries include the module A1-A3, C1-C4 and D, according to the requirements of the reference standard EN 15804+A2:2019, with an approach “from cradle to gate with modules C1–C4 and module D”.

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The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of *EN 15804+A2*. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2010*
☐ internally ☒ externally

Dipl. Ing. Hans Peters
(chairman of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))

Mrs Kim Allbury
(Independent verifier)

2. Product

2.1 Product description/Product definition

The average sanitary acrylic product derives from a group of products including bathtubs, shower trays and bath panels. Materials involved in acrylic production are acrylic sheets (PMMA - polymethyl methacrylate), synthetic resin (polyester resin), glass fibre, calcium carbonate and wood. Particularly, the study focuses on the average acrylic product resulting from the total mass produced for the acrylic products of the considered group in the reference year 2019.
Bathtubs are made of a thermoformed acrylic base body which is enhanced with the help of wood and a fiberglass-resin mixture from the bottom.

For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies. The product needs a declaration of performance taking into consideration EN 14516:2006+A1:2010 - Baths for domestic purposes and EN 14527:2006+A1:2010 - Shower trays for domestic purposes. For the application and use the respective national provisions apply.

2.2 Application

The sanitary acrylic group includes bathtubs, shower trays and bath panels used in bathrooms. Bathtubs and shower trays are furnishings for bathrooms, which are used in particular for personal hygiene. Bath panels, instead, is used as an accessory for bathtubs.

2.3 Technical Data

Depending on the model, installation accessories used and the respective structural situation, bathtubs and shower trays by Duravit fulfil individual or several sound insulation standards. These include: *DIN 4109 (A1), VDI 4100, SIA 181*.
The product dimensions on delivery are listed in the following table according to length (L), width (W) and height (H). No other technical data is of relevance for the sanitary acrylic product group object of the study.

Technical data

Name	Value	Unit
Bathtubs L x W x H	1400 – 2100 x 700 – 1800 x 320 – 560	mm
Shower trays L x W x H	800 – 1800 x 700 – 1200 x 35 – 85	mm
Bath panels L x W x H	700 – 5484 x 4 – 5 x 515 – 575	mm
Temperature change resistance acc. to DIN EN 14516/EN 14527 (for bathtubs and shower trays)	CL1 + CL2	-
Chemical resistance acc. to DIN EN 14516/14527 (for bathtubs and shower trays)	CL1 + CL2	-
Anti-slip classification acc. to DIN 51097 (for bathtubs and shower trays)	-	-
Formaldehyde emissions acc. to EN 717-1	< 124	µg/m^3

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to DIN EN 263: 2008-06 - Sanitary appliances. Crosslinked cast acrylic sheets for baths and shower trays for domestic purposes.

2.4 Delivery status

The product weights on delivery, inluding packaging and accessories such as feet, are listed below.

- Bathtubs: 19.45 - 103.95 kg
- Shower trays: 12.41 - 39.24 kg
- Acrylic bathtub panels: 12 - 40 kg

2.5 Base materials/Ancillary materials

The list below provides an overview of the average composition (% by mass) of sanitary acrylic.

- PMMA sheets: 14.1 % – 22.3 %
- Polyester resin: 16.5 % – 29.5 %
- Glass fibre: 7.8 % – 25.8 %
- Wood: 26.9 % – 41.5 %
- Acetone: < 1 %
- Calcium carbonate: < 1 %
- Catalyst: < 1 %
- Pigment: < 1 %
- Cobalt: < 1 %

2.6 Manufacture

The acrylic (PMMA) sheets are first cleaned, freed of dust and other foreign particles, cut to size and then thermoformed in an electrically powered oven at 180°C to be drawn into a preformed shape. After the cooling phase, the acrylic mould is sprayed with a mixture of polyester resin, glass fibre, acetone and calcium carbonate. Additional components of the mixture for polymerization are methyl ethyl ketone peroxide (catalyst), titanium dioxide (pigment) and cobalt (hardening accelerator). An additional layer of wood panels, sprayed with polyester resin-glass fibre mixture, ensures stability. The mixture is then compressed and once the curing is complete product is subjected to the finishing stage: (i) unnecessary edges are cut and smoothed and (ii) holes are drilled for waste valve and other accessories. The products are mainly packed in film and cardboard and fixed to the pallets with stretch film. The moulds, mainly made of polyester resin, fibreglass, epoxy resin and metal, for the deep drawing of the heated acrylic sheets are also produced at the Cairo plant which is certified according to ISO 9001.

2.7 Environment and health during manufacturing

Methods conforming with the respective standards and laws governing health protection and environmental protection are guaranteed during the entire sanitary acrylic manufacturing process.
The Cairo production plant is certified according to *ISO 14001* and *ISO 45001*.

2.8 Product processing/Installation

There are no particular requirements on machines to be used or dust extraction during installation. The tools required or the use of additional ancillary materials is listed in the assembly instructions supplied with each product.

2.9 Packaging

The products are packed in film and cardboard, which are then fixed to the pallets with stretch film. Some products are also protected against transport damage with wood and foam. Because of their characteristics, all these packagings can be recycled at their end of life.

2.10 Condition of use

No particular features arise in the material composition of the product during use.

2.11 Environment and health during use

Sanitary acrylic basically comprises a pore-free and smooth surface, is UV-stable, dyed through and colour-fast. It is resistant to cleaning agents as well as being easy to assemble and clean. During use, no indications of interactions between the product, environment and health could be identified.

2.12 Reference service life

If used and cared for appropriately, the sanitary acrylic product may last up to several generations.

2.13 Extraordinary effects

Fire
Sanitary acrylic (PMMA) is classified as construction product class B2 (normally flame-resistant) in accordance with *DIN 4102-1*, and therefore approved for a variety of indoor and outdoor applications. Sanitary acrylic is also classified as non-burning dripping in accordance with *DIN 4102-1*. In the event of a fire, sanitary acrylic burns practically without smoke, does not develop and acute toxic smoke gas and does not have a corrosive effect. As sanitary acrylic is practically free of halogen compounds, no halogenated secondary products are incurred.

Fire protection

Name	Value
Building material class	B2
Burning droplets	d0
Smoke gas development	s1

Above values are compliant with EN 13501-1:2007+A1:2010 - Fire classification of construction products and building elements.

Water
In the event of unforeseen impact by water (e.g. flooding) on sanitary acrylic, no negative impacts are to be anticipated in terms of product function or the environment.

Mechanical destruction
In the event of minor mechanical damage, no impacts are to be anticipated in terms of sanitary acrylic product function.

2.14 Re-use phase

Even if material recycling of sanitary acrylic products is theoretically possible, however it is very complex because of its multimaterial composition requiring glass fibre and synthetic resin mixture to be separated from the other components in order to allow polymethyl methacrylate (PMMA) recovery. Thus the current disposal solution involves thermal treatment with energy recovery.

2.15 Disposal

According to the company knowhow acrylic product at its end of life is send to a shredder followed by incineration treatment with thermal energy recovery. According to the *European Waste Index*, the waste flow disposed at the end of life can be identified by the code 170203 - Building and demolition waste: plastic.

2.16 Further information

Additional information available online at www.duravit.de

3. LCA: Calculation rules

3.1 Declared Unit

A declared unit of 1 m² of acrylic surface of an average product including bathtubs and shower trays, as well as acrylic panels, is used as the basis for calculating the life cycle assessment. All environmental impacts of the product are related to 1 m² of acrylic surface. Because of the identical manufacturing method, an average acrylic product made of bathtubs and shower trays, as well as acrylic panels, has been considered according to the total mass produced for the respective acrylic products for the reference year 2019. Product accessories are not considered within this study since the analysis of elements such as electronic parts and nozzles for bathtub systems would be beyond the scope of this study. Moreover, other accessories like feet and foot systems are also excluded since the are almost avoided in the products under study.
The thickness of the acrylic surface coating can be distinguished as follows for the respective products:

- Bathtubs: 4 - 5 mm
- Shower trays: 3.2 - 4 mm
- Panels: 4 - 5 mm

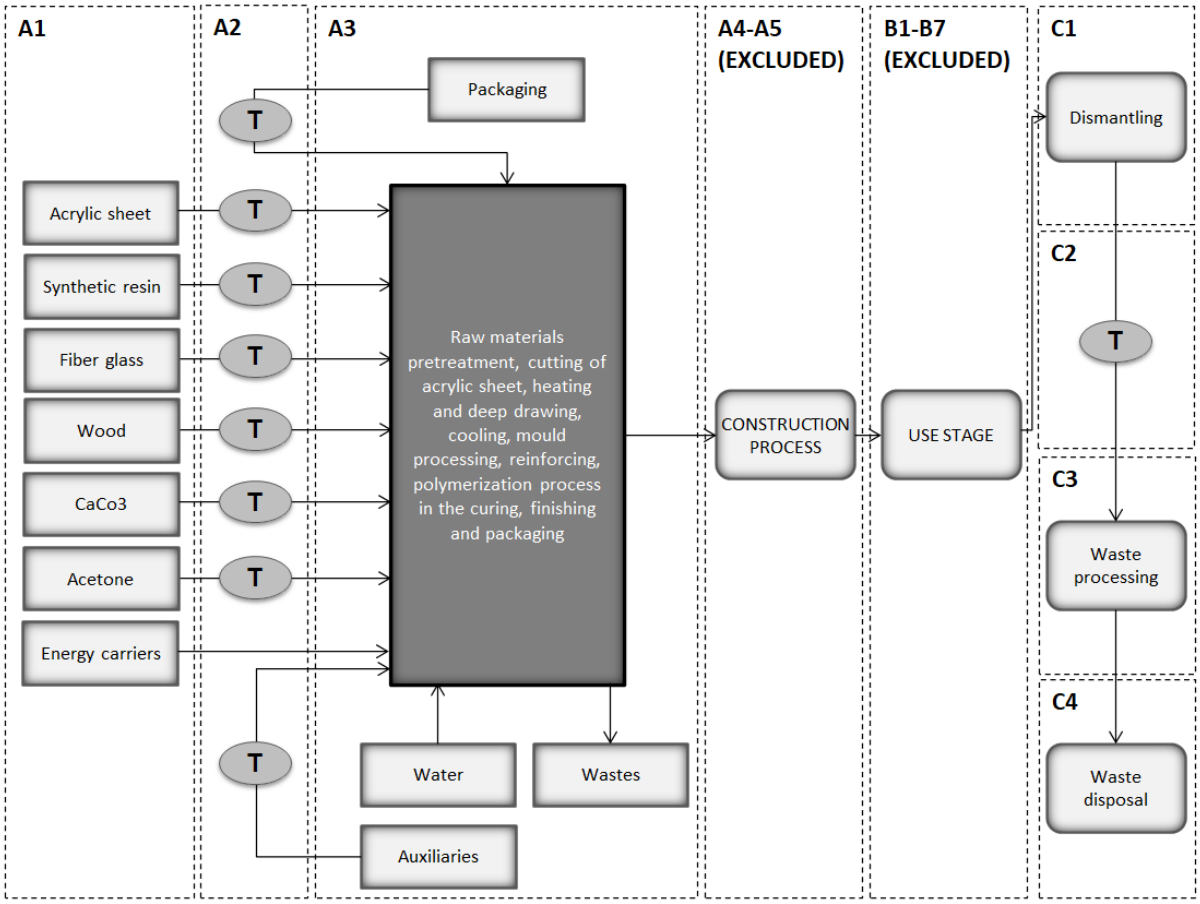
The density of PMMA plates is indicated in the literature as 1190 kg/m³ , resulting in an average product weight (without packaging) equal to 17.91 kg per declared unit (1 m²). The packaging is defined with a weight of 0.21 kg per declared unit*.
*Additional technical information (i.e. specific dimensions and weight) about each (every) single product (bathtubs, shower trays and bath panels) making the average product are available at: https://pro.duravit.de/pro/content/homepage/produkte/kategorien/uebersicht~402880943a1b6e1b013a1bd065b4001f.de-de.html?categories=
The conversion from mass (kg) of product to the equivalent surface (m^2) needs to be performed multiplying the mass value by the conversion factor highlighted in the below table (0.055).

Declared unit

Name	Value	Unit
Declared unit : acrylic surface	1	m^2
Mass : acrylic surface of the declared unit	17.91	kg
Layer thickness : acrylic surface	3.2 - 5	mm
Conversion factor to 1 kg without accessory (mass per declared unit)	17.91	-

3.2 System boundary

The system boundaries include the module A1-A3, C1-C4 and D with an approach “from cradle to gate with modules C1–C4 and module D”. Construction, maintenance and decommissioning of infrastructures (in terms of buildings) and the occupation of industrial land are not part of the assessment since their contribution is negligible. Moreover, construction process stage (modules A4-A5) and use phase (modules B1-B7) are not included in the assessment. Particularly, because of the type of product assessed, C1 and C3 results both equal to zero.



3.3 Estimates and assumptions

Some assumption have been made according to as follow:

- wood (reinforcing) was modelled considering 100 % of wood chips for laminated board;
- foil (packaging) was modelled considering packaging film in low-density polyethylene;
- stench (packaging) was modelled considering packaging film in low linear density polyethylene;
- transport of cobalt, thinner and lubricant was assumed for a local distance of 50 km;
- EoL waste shredding treatment was modelled assuming an electricity consumption of 0.02852 kWh/kg derived from Ecoinvent dataset for plastic flake consumer electronics recycling by grinding/shredding.

When no datasets were available for the Egypt context, European and global datasets were adopted.

3.4 Cut-off criteria

The consumption of paint (logo), glue, paper (instruction manual) and the respective transport to the Egyptian plant have been neglected resulting in a total incidence by mass lower than 0.01 %.

3.5 Background data

Ecoinvent database v.3.6 was used for background processes. International and national literature have been also adopted, particularly about parameters like energy efficiency of incineration plant in Europe and Germany, waste treatment scenarios and quality of recovered materialin Egypt, Europe and Germany (see par.8 for references).

3.6 Data quality

Data have been collected according to the following requirements:

- Time coverage: primary data cover a period of 12 months (January 2019 - December 2019), while databases are not older than 10 years.
- Geographical coverage: data refer as much as possible to the specific geography context, e.g. electricity consumption at Cairo modelled with national grid mix. For downstream modules, the European context has been considered for waste disposal at the EoL according to the real distribution of the final product.
- Technological coverage: data collected refer to the state of the art of the technologies used for the production of materials.
- Accuracy: data collected refer to specific consumption and measurements.
- Completeness: the percentage of mass flow included in the study can be considered to be more than 99 %.
- Representativeness: information were collected specifically on site for the product under study.
- Consistency: the methodology applied in this study has been extended uniformly to the different parts of the analysis.

- Reproducibility: data were collected through the use of data collection forms (Excel file) filled directly by company operators.
- Data sources: data derived from primary and secondary sources like internationally recognized databases.
- Uncertainty: it has been assessed through a Monte Carlo method.

Scoring from 1 to 5 (very good, good, fair, poor, very poor) has been adopted for the data quality levels according to the EN 15804+A2:2019 at Annexe E (table E.2). The Data Quality Rating (DQR), instead, will correspond to a data quality level defined as follows:

- Overall data quality rating (DQR) from 1.6: excellent quality
- Overall data quality rating (DQR) from 1.6 to 2.0: very good quality
- Overall data quality rating (DQR) from 2.0 to 3.0: good quality
- Overall data quality rating (DQR) from 3 to 4.0: fair quality
- Overall data quality rating (DQR) > 4: poor quality

The value obtained for DQR (Data Quality Rating) in this study is equal to 2.42 (good quality).

3.7 Period under review

Primary data, covering the reference period January 2019 – December 2019, include particularly:

- Inbound transport of raw materials, packaging and auxiliaries to the production plant at Cairo.
- Waste produced during the production of the assessed product (type and quantity).
- Bill of materials for the whole yearly acrylic production (type and quantity), also including information about other different productions of the plant (e.g. ABS panels).
- Co-products related to the main product (type and quantity).
- Production processes involved in acrylic production, including energy mix (electricity and heat) and water consumed at the plant.

3.8 Allocation

The assignment of the production data has been carried out on site by Duravit, subtracting the number of materials consumed for other clients different from Duravit. Moreover, separate electricity meters for the Duravit production line enable precise indication of the annual electricity consumption for Duravit only.
An allocation by mass (based on the annual production) was applied to the inventory flows of packaging, auxiliaries, chemicals, water, energy carriers and wastes since, in addition to acrylic, ABS (acrylonitrile butadiene styrene) is also used for panel production. Wastes have been also allocated by mass since they referred to the whole plant (including also production for other clients).
Considering EoL (module C4), impacts from incineration were assumed with a 50-50 allocation approach according to the fact that R1 is higher than 0.6 but specific primary data are missing.

3.9 Comparability

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

For background data *Ecoinvent database* (Version 3.6) was used.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon
The biogenic carbon content of wood-based products has been calculated according to EN 16449, Wood and wood-based products — Calculation of the biogenic carbon content of wood and conversion to carbon dioxide.

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic Carbon Content in product	1.92	kg C
Biogenic Carbon Content in accompanying packaging	0.09	kg C

Considering biogenic carbon content in the product (as C), a value equal to 12 % of moisture content in wood has been assumed.

Additional technical scenario information for module A5 (not declared in this study) are provided. Particularly, product packaging is represented by corrugated board box, foil (low-density polyethene LDPE), stretch film (linear low-density polyethene LLDPE), wood, foam (PS) and filler- spacers (PS) characterized at their EoL according to the national scenario of each country where the product will be finally installed. Beyond foil (LDPE), stretch film (LLDPE), foam (PS) and filler-spacers (PS) are not significant because of their very low incidence in mass and considering that wood may be reused many times before being disposed of, the corrugated board box is the only packaging affecting the mass balance of GWP-biogenic. Thus, the amount of 0.339 kg CO_2 eq biogenic removed from the air because of the corrugated board box has to be considered balanced by an equivalent re-emission occurring in module A5.

End of life (C1 - C4)

Name	Value	Unit
Energy recovery Incineration	17.91	kg

According to the characteristics of the product under study, which basically required dismantling operations mainly by hand, C1 has been assumed equal to zero. In C2, instead, a distance of 100 km has been assumend for the trasportation to the waste treatment plant. Considering C3 and C4, the product is basically

disposed to waste incineration plant (with energy recovery), allocated to module C4 together with a pre-treatment by waste shredding allocated again to module C4 (resulting in a C3 equal to zero). Because of the difficulties in collecting information to characterize an average global waste disposal scenario, it was assumed the European context as a good proxy according to the fact that about 60 % of the product is delivered within Europe. Thus, the disposal of the final product at the end of its life was modelled through assumptions based on a literature review about waste incineration in Germany which has been considered as a good proxy for the whole European context.

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Mass of product to EoL	17.91	kg

Wastes generated by the production plant at Cairo and at the end-of-life stage of the acrylic product have been modelled applying the derived Circular Footprint Formula described in EN 15804+A2:2019 - Annexe D. Since in this study only energy recovery occurs, thus only the formulae for loads and benefits related to the export of energy as a result of waste incineration (*module D3*) have been applied.

The amount of PMMA (EoL) considered in modelling of module D accounts only for materials that will give energy during incineration, thus PMMA sheets, polyester resin and wood resulting in a total final weight of 12.39 kg. Other main components glass fibre and calcium carbonate will not produce any energy during incineration.

5. LCA: Results

The following results for the 2019 Duravit sanitary average acrylic product from the plant at Cairo (Egypt) are given, unless otherwise indicated, per m² of acrylic surface.

Disclaimer:

EP-freshwater: This indicator has been calculated as “kg P eq” as required in the characterization model (EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe; http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml).

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	ND	ND	ND	ND	MNR	MNR	MNR	ND	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m² acrylic surface

Core Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	[kg CO_2-Eq.]	7.19E+1	1.67E+0	4.17E+0	0.00E+0	2.29E+0	0.00E+0	2.72E+1	-2.07E-2
GWP-fossil	[kg CO_2-Eq.]	7.89E+1	1.66E+0	4.51E+0	0.00E+0	2.29E+0	0.00E+0	2.02E+1	-2.06E-2
GWP-biogenic	[kg CO_2-Eq.]	-6.99E+0	2.88E-4	-3.39E-1	0.00E+0	6.25E-4	0.00E+0	6.99E+0	-5.77E-5
GWP-luluc	[kg CO_2-Eq.]	1.52E-2	8.04E-4	1.41E-3	0.00E+0	2.12E-4	0.00E+0	9.18E-4	-2.35E-5
ODP	[kg CFC11-Eq.]	3.60E-6	3.55E-7	8.96E-8	0.00E+0	4.99E-7	0.00E+0	6.68E-8	-1.48E-9
AP	[mol H^+-Eq.]	3.94E-1	2.58E-2	5.19E-3	0.00E+0	1.45E-2	0.00E+0	6.90E-3	-7.45E-5
EP-freshwater	[kg P-Eq.]	7.74E-3	1.16E-4	2.82E-4	0.00E+0	4.79E-5	0.00E+0	2.56E-4	-6.44E-6
EP-marine	[kg N-Eq.]	6.44E-2	6.99E-3	2.49E-3	0.00E+0	5.82E-3	0.00E+0	3.13E-3	-1.47E-5
EP-terrestrial	[mol N-Eq.]	6.20E-1	7.73E-2	1.59E-2	0.00E+0	6.39E-2	0.00E+0	2.73E-2	-1.50E-4
POCP	[kg NMVOC-Eq.]	2.69E-1	2.06E-2	1.34E-1	0.00E+0	2.25E-2	0.00E+0	6.71E-3	-4.28E-5
ADPE	[kg Sb-Eq.]	6.11E-4	3.11E-5	7.74E-5	0.00E+0	1.35E-5	0.00E+0	8.50E-6	-2.56E-8
ADPF	[MJ]	1.21E+3	2.36E+1	1.17E+1	0.00E+0	3.12E+1	0.00E+0	8.87E+0	-2.87E-1
WDP	[m^3 world-Eq deprived]	2.09E+1	6.69E-2	2.55E-1	0.00E+0	2.48E-2	0.00E+0	1.07E+0	-2.22E-3

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m² acrylic surface

Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	[MJ]	6.37E+1	0.00E+0	1.27E+0	0.00E+0	0.00E+0	0.00E+0	7.59E-1	-1.85E-2
PERM	[MJ]	3.06E+1	0.00E+0	6.48E-1	0.00E+0	0.00E+0	0.00E+0	1.09E-1	-2.38E-3
PERT	[MJ]	9.42E+1	0.00E+0	1.92E+0	0.00E+0	0.00E+0	0.00E+0	8.68E-1	-2.09E-2
PENRE	[MJ]	3.20E+2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRM	[MJ]	8.87E+2	0.00E+0	1.17E+1	0.00E+0	0.00E+0	0.00E+0	8.87E+0	-2.86E-1
PENRT	[MJ]	1.21E+3	0.00E+0	1.17E+1	0.00E+0	0.00E+0	0.00E+0	8.87E+0	-2.86E-1
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	5.32E-1	2.28E-3	7.12E-3	0.00E+0	1.10E-3	0.00E+0	3.44E-2	-9.99E-5

Caption	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

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m² acrylic surface

Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD	[kg]	4.20E-4	4.79E-5	7.44E-5	0.00E+0	8.38E-5	0.00E+0	1.48E-5	-2.24E-7
NHWD	[kg]	2.67E+0	9.91E-1	4.05E-1	0.00E+0	1.48E-1	0.00E+0	6.01E-1	0.00E+0
RWD	[kg]	0.00E+0	1.58E-4	3.29E-5	0.00E+0	2.21E-4	0.00E+0	2.57E-5	-5.52E-7
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	2.54E-1	0.00E+0	0.00E+0	0.00E+0	2.54E-1	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	9.74E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

Caption	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; EEE = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m² acrylic surface

Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
PM	[Disease Incidence]	3.35E-6	1.13E-7	3.79E-7	0.00E+0	3.10E-7	0.00E+0	3.77E-8	-4.96E-10
IRP	[kBq U235-Eq.]	1.62E+0	1.10E-1	4.00E-2	0.00E+0	1.41E-1	0.00E+0	6.88E-2	-1.90E-3
ETP-fw	[CTUe]	1.13E+3	1.91E+1	8.63E+2	0.00E+0	1.78E+1	0.00E+0	5.16E+1	-2.51E-1
HTP-c	[CTUh]	2.79E-8	8.04E-10	7.07E-9	0.00E+0	2.87E-10	0.00E+0	1.96E-9	-3.38E-12
HTP-nc	[CTUh]	8.95E-7	1.95E-8	4.60E-8	0.00E+0	1.24E-8	0.00E+0	7.68E-8	-1.27E-10
SQP	[-]	3.23E+2	1.44E+1	6.60E+0	0.00E+0	5.43E+0	0.00E+0	2.10E+0	-2.97E-2

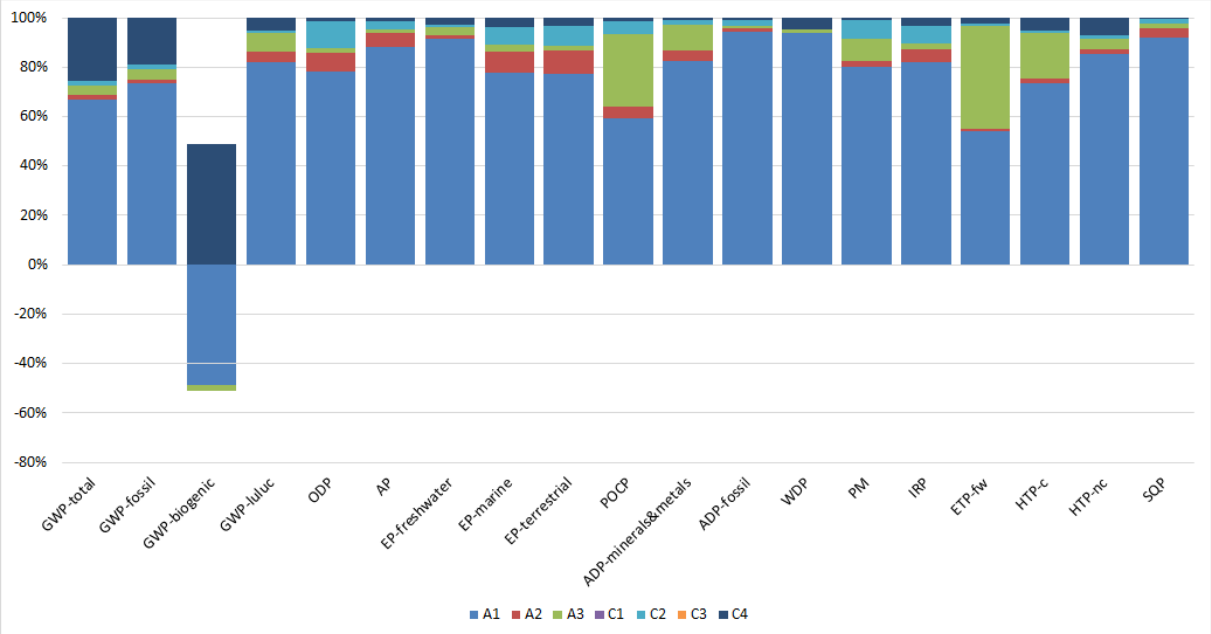
Caption	PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator "potential Human exposure efficiency relative to U235".
This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators: "abiotic depletion potential for fossil resources", "abiotic depletion potential for non-fossil resources", "water (user) deprivation potential", "deprivation-weighted water consumption", "potential comparative toxic unit for ecosystems", "potential comparative toxic unit for humans - cancer effects", "potential comparative toxic unit for humans – non-cancer effects", "potential soil quality index".
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.

6. LCA: Interpretation

Results are discussed below providing also their graphycal representation:



Above results highlight that module A1 (extraction and provision of the raw materials) is the one characterized by the most part of the environmental impacts with an average incidence of 73 % (values varying between -49 % and 94 %). The second largest contribution to the total impacts comes from module A3, with an average incidence of 8 % (values varying between 1 % and 42 %), where manufacturing processes dominate the impact categories POCP (30 %), ADP-minerals&metals (10 %), PM (9 %), ETP-fw (42 %), HTP-c (19 %). Module C4, with waste disposal characterized by an average impact of 7 % (values varying between 1 % and 49 %), accounts for relative high impacts for the categories of GWP-fossil (19 %), GWP-biogenic (49 %) and HTP-nc (7 %). Considering module D, characterized by overall negative (thus benefits) values, credits from waste disposal arise from the electrical and thermal energy

gained from the waste incineration plant. However, these credits are not significant.
The total use of renewable and non-renewable primary energy also reveals a similar situation as this is also dominated by the module A1 extraction and provision of raw materials phase, with an average incidence of 96 %.

7. Requisite evidence

7.1 Formaldehyde test

The following material components of sanitary acrylic are continuously tested for formaldehyde:

- Acrylic
- GRP (glass fibre reinforced plastic)
- Wood (measurement to *EN 717-1*)

Evidence can be supplied by the manufacturer.

7.2 Antimicrobial tests

As a general rule, the tests referred to above for sanitary acrylic products are regulated by the *DIN EN 263*.

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