Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for:

Acryl Bathtub and Shower Tray Products

from

Villeroy and Boch AG.
Saaruferstraße, 66693 Mettlach (Germany)

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General information

Programme information

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Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): *Construction products, 2019:14, version 1.11*
PCR review was conducted by: Martin Erlandsson, IVL Swedish Environmental Research Institute, martin.erlandsson@ivl.se
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: *prof. Ing Vladimír Kočí, PhD., Prague, Czech Republic, vladimir.koci@lca.cz* *Approved verifier by: The International EPD® System*
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ERM — EPD prepared by ERM LTD. Exchequer court, 33 St Mary Axe, Lime Street, London EC3A 8AA www.erm.com

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Company information

Owner of the EPD:

Villeroy & Boch AG

Contact:

Giuseppe Noto,

Noto Giuseppe Noto.Giuseppe@villeroy-boch.com

Mobile: +49(0) 151 162 665 86

Description of the organisation:

This EPD study on 'Acryl bathtub and shower tray products' was commissioned by Villeroy & Boch (V&B), one of the largest providers of "Bathroom, Wellness and Tableware" related products in Europe. With its head office based in Germany (Saaruferstraße, 66693 Mettlach) V&B is a major manufacturer of sanitary ware products, which are sold in around 125 countries.

Product-related or management system-related certifications:

DIN EN ISO 9001:2015 – Quality Management System

DIN EN ISO 14001:2015 – Environmental Management System

DIN EN ISO 50001 :2018 – Energy Management System

DIN EN ISO 45001 :2018 – Occupational Health and Safety Management System

Name and location of production site:

The Acryl products assessed in this study are manufactured in Belgium at Villeroy & Boch Wellness, Populierstraat 1, 8800 Roeselare.

Product information

Product name:

Acryl bathtubs and shower trays.

Product identification:

The bathtubs and shower trays assessed in this report are part of the Acryl product series. For this series the dominant raw materials are polymethylmethacrylate sheet (PMMA) and glass reinforced polyester mix (GRP). Shower trays with polyurethane (PUR) have been excluded from this EPD. Sanitary acrylic is frequently used for producing modern bathtubs and shower trays due to the advantageous nature of the material. Acrylic's flexible processing quality means that a wide range of products designs are possible. Additionally, the surface is very pleasant to the skin because of its heat insulating properties that allows sanitary acrylic to quickly adjust to the temperature of the water, particularly noticeable in bathtubs. The pore-free material is proven reliably colour fast, to keep its shine for a long time as well as being slip resistant. Figure 1 illustrates a typical bathtub from the Acryl range of products available from V&B.

Figure 1: Typical Acrylic bathtub product - Architectura Rectangular bath (1900 x 900 mm)

UN CPC Code:

36930 Baths, wash-basins, lavatory pans and covers, flushing cisterns and similar sanitary ware, of plastics.

Product description:

Table 1 shows the typical material composition for Acryl products, consisting of both bathtubs and shower trays.

Table 1: Typical material composition of Acrylic products

Materials	Percentage composition in material
Limestone	26%
Polymethylmethacrylate	24%
Styrene	22%
Glass fibres	8%
Steel	5%
Other e.g. filler, pigments	15%
Total	**100%**

Packaging
Packaging has been assessed for both inbound raw materials and for the outbound finished bathtub and shower tray products.

Recycled material:
No externally sourced recycled material is used in the final product.

LCA information

Functional unit / declared unit:
The declared unit for Acryl products is typically based on finished pieces, however since the focus of this EPD is on the material itself rather than a specific product, the declared unit is:

"1 kg of Acryl product and associated packaging, excluding fixtures and fittings"

As this is a 'cradle-to-gate (A1-A3+C+D)' study and B1 – B7 steps are not included, the declaration of the reference service life (RSL) is not applicable.

Reference service life:
Not applicable

Time representativeness:
LCA calculations were subject to client-specific data from 2020 and based on one-year averaged data.

Geographic representativeness:
The upstream supply chain has been modelled based on production from the V&B manufacturing site in Roeselare, Belgium and supplier locations used to make the Acryl product. It has been assumed that the product will be sold in the EU and the end of life stage will also take place in the EU.

Databases and LCA software used
All primary data used were based on the manufacturer's specific data inventory. Modelling was carried out using GaBi software (version 10.5.1.124). Background life cycle inventory data were primarily sourced from the GaBi 2021 databases, supplemented with data from ecoinvent v3.7, where this was deemed more representative. Country specific data for fuels and energy were used where possible. It was more challenging to find country-specific data for raw materials; if these could not be obtained, European average data were used where available. If the country specific data were not available, the most representative dataset from another location was used.

Description of system boundaries:
System boundary: cradle-to-gate study (A1-A3+C+D).

The LCA addresses the environmental aspects and potential environmental impacts from the point at which raw materials are extracted from the environment through to finished product. The end of life stage is also considered, from removal of the used Acryl products through to the final disposal along with potential benefits and loads beyond the system boundary.

Life cycle stage descriptions are shown below in

Table 2 and

Figure 2.

Table 2: Description of the system boundary according to the PCR

Life cycle stage	Individual stages	Module Code	Use	Geography	Specific Data
Product stage	Raw material	A1	X	Belgium	Villeroy & Boch Site Specific Manufacturing Data (Accounting for raw materials, energy and waste which is > 90% of total)
	Transport	A2	X	Global	
	Manufacturing	A3	X	EU-28	
Construction process stage	Transport	A4	MND	EU-28	-
	Construction Installation	A5	MND	EU-28	-
Use stage	Use	B1	MND	EU-28	-
	Maintenance	B2	MND	EU-28	-
	Repair	B3	MND	EU-28	-
	Replacement	B4	MND	EU-28	-
	Refurbishment	B5	MND	EU-28	-
	Operational energy use	B6	MND	EU-28	-
	Operational water use	B7	MND	EU-28	-
End of life stage	De-construction & demolition	C1	X	GLO	-
	Transport	C2	X	GLO	-
	Waste processing	C3	X	GLO	-
	Disposal	C4	X	EU-28	-
Resource recovery stage	Reuse-Recovery-Recycling-potential	D	X	GLO	-

X = declared modules, MND = module not declared

Figure 2: System Diagram

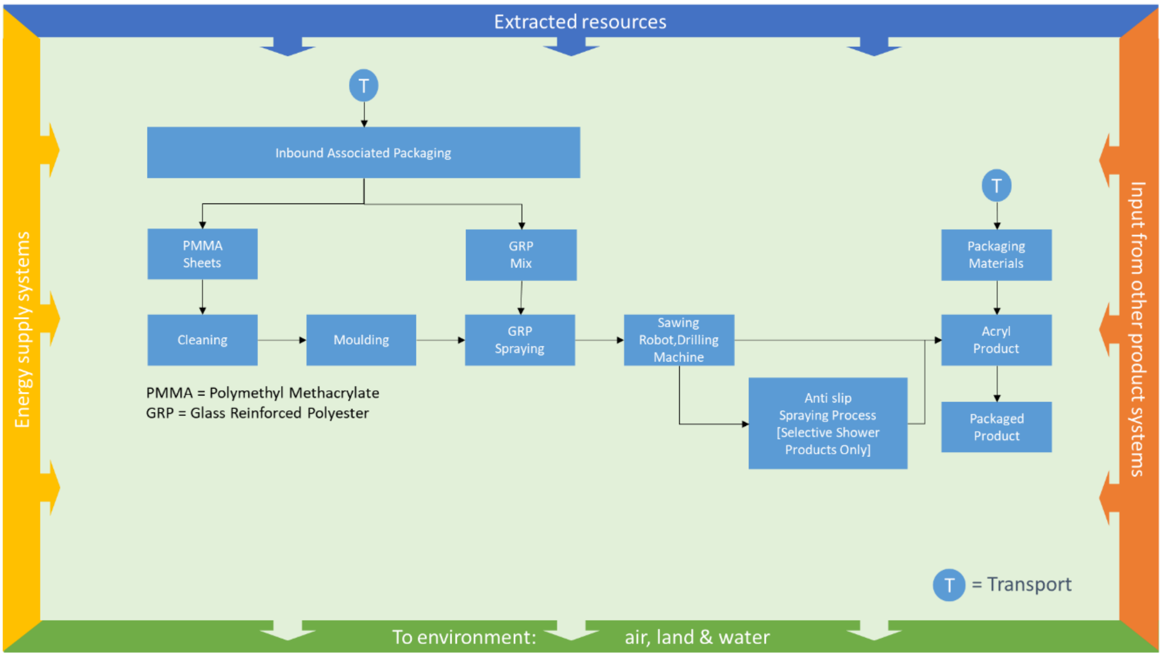


Table 3 summarises those life cycle aspects that have been included within and excluded from the study.

Table 3: Components inclusion/ exclusion

Included	Excluded
▪ Raw material acquisition ▪ Processing of raw materials ▪ Transport of raw materials to V&B manufacturing site ▪ Energy used in production at manufacturing facilities ▪ Assembly of finished product ▪ Transport and disposal/recycling of wastes ▪ Transportation of components to assembly site ▪ Product packaging of final product	▪ Construction activities, capital equipment and infrastructure ▪ Human labour, employee commute and business travel

Description of production process

The manufacturing process of Acryl products begins with the transportation of raw materials and their associated packaging.

Once on-site, the PMMA initially undergoes a cleaning stage to remove any loose dust or dirt. The PMMA sheets are sent to the vacuum moulding process, which forms the sheets into the shape of the desired product.

Following the creation of the plastic shape, the product undergoes GRP spraying, where layers of fibreglass and resin are sprayed onto the PMMA substrate. The fibreglass is flattened with a roller to remove any air and to ensure the resin bonds firmly to the product's surface. The product then goes into a curing tunnel, where an exothermic curing process takes place. At the end of the tunnel, the resin is cured and the product is sawn, drilled and finished.

Holes for water outlet and overflow are made and the edges are smoothed using an air powered grinder.

Some of the shower trays will be sprayed with an anti-slip coating to prevent slippage.

The final Acryl products are then inspected, packaged and sent to the V&B warehouse in Losheim, Germany.

End of life scenario

It has been assumed that, at end of life, the Acryl products would be manually dismantled from where they have been installed during the use stage. Hence no burdens have been allocated to module C1.

It has also been assumed that the dismantled Acryl products would be sent to landfill and this would be 50 km from the location of the building where it was installed. This journey has been modelled using a 32 tonne gross weight truck.

Given their composite nature and choice of materials, Acryl products are not currently suitable for recycling. It is possible that they could be sent for energy recovery but considering the size and nature of the products it is more likely that they would be disposed of to landfill.

At end of life no materials from the Acryl products are recycled or sent for energy recovery. The product is inert in landfill (not producing landfill gas that can be burnt to produce electricity). As such, no potential benefits or loads beyond the system boundary have been identified or modelled.

Data Quality

Data collection followed the guidance provided in ISO 14044:2006, clause 4.3.2. All producer-specific data are from 2020 and are based on one-year averaged data.

ERM collected site-specific data from V&B's operations using structured questionnaires. The data received were cross-checked for completeness and plausibility using mass balances and stoichiometry, as well as internal and external benchmarking.

All background data were obtained from the databases contained within the Gabi 10.5.1.123 software: most data were sourced from the Gabi 2021 database from Sphera, supplemented with data from ecoinvent v3.7. Datasets from these databases have been used worldwide for many years in many critically reviewed studies in industrial and scientific applications. The vast majority of data were sourced from 2017-2020, although a few datasets were older.

Cut-off criteria

EN 15804 requires that where there are data gaps or insufficient input data for a unit process, the cut-off criteria shall be 1% of renewable and non-renewable primary energy usage and 1% of the total mass of this unit process. The total neglected flows from a product stage must be no more than 5% of product inputs by mass or 5% of primary energy contribution.

All emissions and their environmental impact contributing greater than 1% to the total must be recorded.

In this assessment, all information gathered from data collection for the production of the Acryl products has been modelled, ie all raw materials used, the electrical energy and other fuels used, use of ancillary materials and all direct production waste. Transport data on input and output flows have also been considered.

Allocation

V&B's manufacturing site in Roeselare only produces Acryl products, with no co- or by-products. As such, no allocation has been necessary.

Assumptions and Limitations

This EPD does not assess the installation and use stages associated with the Acryl product life cycle. The end of life of the Acryl products has been modelled based on what is currently the most likely scenario, but this may not be representative of the end of life of a newly installed product that would be disposed of some years in the future, eg if recycling of post-consumer acrylics were to become more widespread.

Further Information

Additional information on Acryl products can be found at:

https://www.villeroyboch-group.com/en.html

https://www.villeroy-boch.com/bath-and-wellness/products.html

https://pro.villeroy-boch.com/us/us/bathroom-and-wellness.html

Environmental Information

Potential environmental impact

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
GWP - total [kg CO2 eq.]	2.56E+00	4.08E-02	2.44E-01	0.00E+00	3.26E-02	0.00E+00	2.30E-01	0.00E+00	3.11E+00
GWP - fossil [kg CO2 eq.]	3.03E+00	4.05E-02	1.10E-01	0.00E+00	3.23E-02	0.00E+00	2.34E-02	0.00E+00	3.24E+00
GWP – biogenic [kg CO2 eq.]	-4.70E-01	-5.17E-05	1.34E-01	0.00E+00	-4.15E-05	0.00E+00	2.06E-01	0.00E+00	-1.30E-01
GWP - luluc [kg CO2 eq.]	4.30E-03	3.33E-04	4.36E-06	0.00E+00	2.66E-04	0.00E+00	5.08E-05	0.00E+00	4.95E-03
ODP [kg CFC-11 eq.]	1.20E-07	5.19E-18	8.03E-17	0.00E+00	4.16E-18	0.00E+00	7.74E-17	0.00E+00	1.20E-07
AP [Mole of H+ eq.]	8.87E-03	4.11E-05	1.20E-04	0.00E+00	2.91E-05	0.00E+00	1.52E-04	0.00E+00	9.21E-03
EP - freshwater [kg P eq.]	1.63E-04	1.21E-07	1.87E-08	0.00E+00	9.65E-08	0.00E+00	5.44E-07	0.00E+00	1.64E-04
EP - marine [kg N eq.]	2.03E-03	1.29E-05	4.78E-05	0.00E+00	8.41E-06	0.00E+00	4.77E-05	0.00E+00	2.15E-03
EP - terrestric [Mole of N eq.]	2.19E-02	1.54E-04	6.07E-04	0.00E+00	1.04E-04	0.00E+00	4.76E-04	0.00E+00	2.32E-02
POCP [kg NMVOC eq.]	6.56E-03	3.54E-05	1.23E-04	0.00E+00	2.43E-05	0.00E+00	1.89E-04	0.00E+00	6.93E-03
ADPF [MJ]	7.58E+01	5.41E-01	1.34E-01	0.00E+00	4.33E-01	0.00E+00	3.14E-01	0.00E+00	7.72E+01
ADPE [kg Sb eq.]	2.77E-06	3.09E-09	6.53E-10	0.00E+00	2.48E-09	0.00E+00	1.96E-09	0.00E+00	2.78E-06
WDP [m³ world equiv.]	4.69E-01	3.53E-04	4.05E-02	0.00E+00	2.82E-04	0.00E+00	2.37E-03	0.00E+00	5.13E-01

Caption: GWP - total = global warming potential; GWP - fossil = global warming potential (fossil fuel only); GWP - biogenic = global warming potential (biogenic); GWP - luluc = global warming potential (land use only); ODP = ozone depletion; AP = acidification terrestrial and freshwater; EP - freshwater = eutrophication potential (freshwater); EP - marine = eutrophication potential (marine); EP- terrestric = eutrophication potential (terrestrial); POCP = photochemical ozone formation; ADPE = abiotic depletion potential (element), ADPF = abiotic depletion potential (fossil); WDP = water scarcity.

Potential environmental impact - describing GWP-GHG based on EN 15804:2012+A1:2013 (previous version)

	A1	A2	A3	C1	C2	C3	C4	D	Total
Total [kg CO2 eq.]	2.46E+00	3.98E-02	2.44E-01	0.00E+00	3.18E-02	0.00E+00	1.73E-01	0.00E+00	2.95E+00

Use of resources

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
PERE [MJ]	1.05E+01	3.02E-02	2.27E-02	0.00E+00	2.42E-02	0.00E+00	3.52E-02	0.00E+00	1.06E+01
PERM [MJ]	2.39E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E+00
PERT [MJ]	1.29E+01	3.02E-02	2.27E-02	0.00E+00	2.42E-02	0.00E+00	3.52E-02	0.00E+00	1.30E+01
PENRE [MJ]	6.04E+01	5.42E-01	1.33E-01	0.00E+00	4.34E-01	0.00E+00	3.15E-01	0.00E+00	6.18E+01
PENRM [MJ]	1.54E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E+01
PENRT [MJ]	7.58E+01	5.42E-01	1.33E-01	0.00E+00	4.34E-01	0.00E+00	3.15E-01	0.00E+00	7.72E+01
SM [kg]	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
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 [m3]	1.98E-02	3.45E-05	9.50E-04	0.00E+00	2.77E-05	0.00E+00	7.01E-05	0.00E+00	2.09E-02

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

Waste production and output flows

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
HWD [kg]	1.44E-08	2.73E-11	2.46E-11	0.00E+00	2.18E-11	0.00E+00	4.18E-11	0.00E+00	1.45E-08
NHWD [kg]	6.70E-02	8.05E-05	3.00E-02	0.00E+00	6.44E-05	0.00E+00	1.07E+00	0.00E+00	1.17E+00
RWD [kg]	2.71E-03	6.55E-07	6.07E-06	0.00E+00	5.24E-07	0.00E+00	3.43E-06	0.00E+00	2.72E-03
CRU [kg]	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
MER [kg]	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
MFR [kg]	5.11E-04	0.00E+00	1.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.10E+00
EEE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00
EET [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

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; EET = Exported thermal energy

Information on biogenic carbon content

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
Biogenic carbon content in product [kg]	1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-03
Biogenic carbon content in packaging [kg]	6.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-02

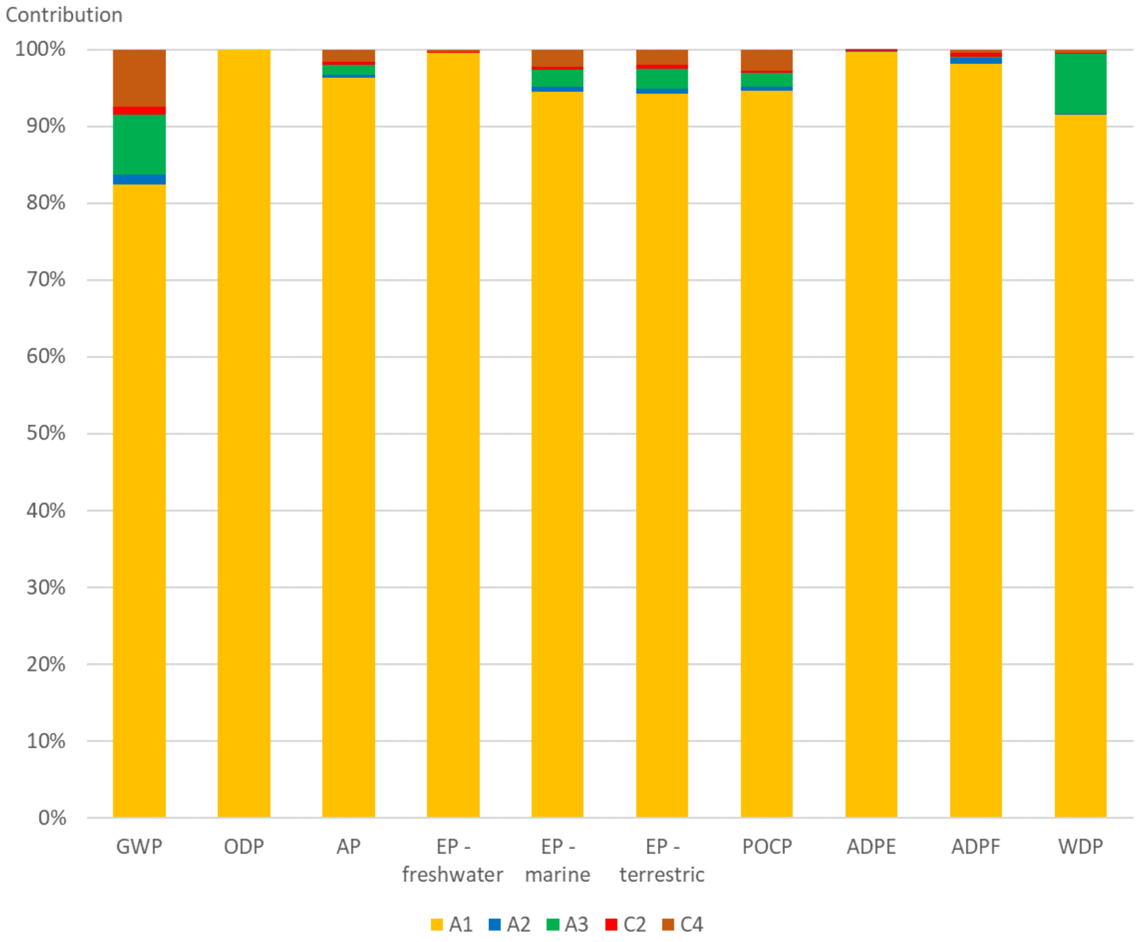
Other environmental indicators

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
PM [Disease incidences]	1.34E-07	2.64E-10	6.81E-10	0.00E+00	1.84E-10	0.00E+00	1.76E-09	0.00E+00	1.37E-07
IR [kBq U235 eq.]	3.11E-01	9.38E-05	9.40E-04	0.00E+00	7.51E-05	0.00E+00	4.11E-04	0.00E+00	3.13E-01
ETF-fw [CTUe]	5.18E+01	3.91E-01	6.70E-02	0.00E+00	3.13E-01	0.00E+00	1.78E-01	0.00E+00	5.27E+01
HTP-c [CTUh]	1.10E-09	7.89E-12	5.72E-12	0.00E+00	6.31E-12	0.00E+00	2.16E-11	0.00E+00	1.14E-09
HTP-nc [CTUh]	6.40E-08	4.07E-10	8.51E-10	0.00E+00	3.25E-10	0.00E+00	2.50E-09	0.00E+00	6.81E-08
SQP [Pt]	1.05E+02	1.86E-01	3.05E-02	0.00E+00	1.49E-01	0.00E+00	4.81E-02	0.00E+00	1.05E+02

Caption: PM = Particulate matter emissions; IR = Ionizing radiation, human health; ETF-fw = Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects, SQP = Soil quality potential/ Land use related impacts

Interpretation

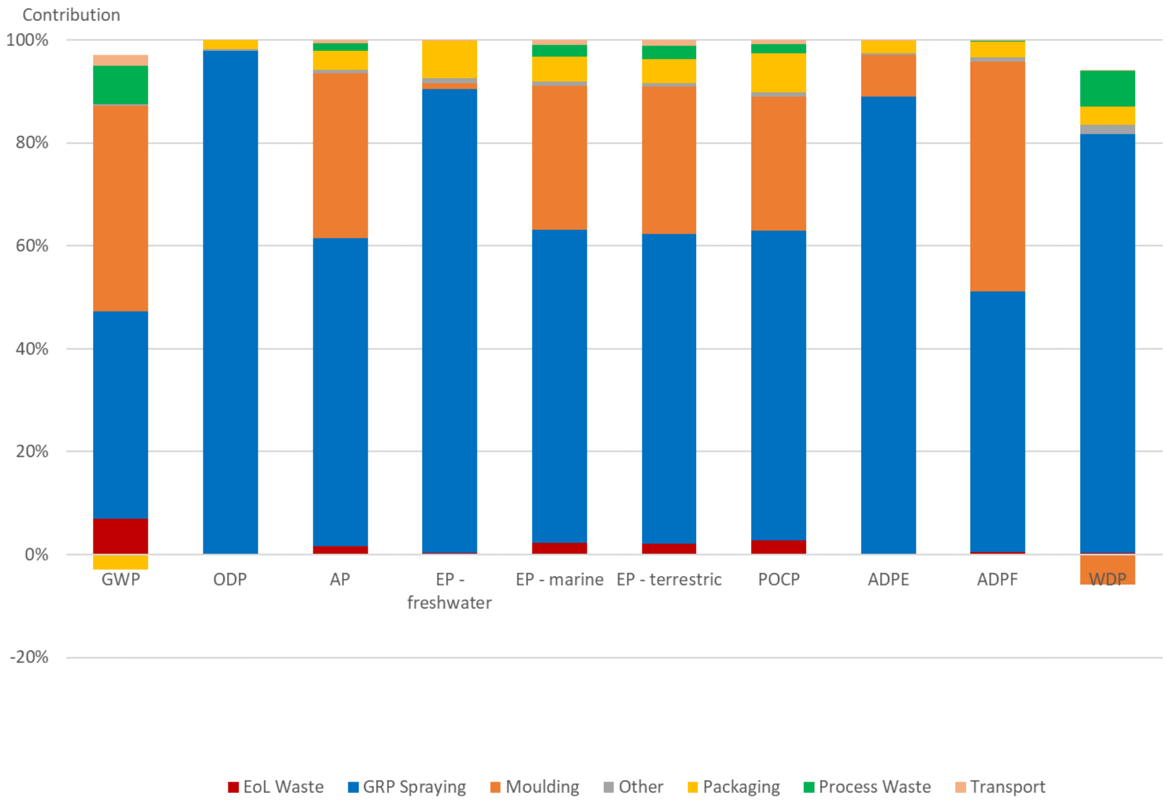
Figure 3: Contribution of modules (A1, A2, A3, C2 and C4) to environmental impact categories for Acryl products.



The results show that module A1 (raw material supply) is the dominant contributor to the majority of environmental impact categories, accounting for 90% or above, of burdens for every impact category. Burdens associated with module A3 are the next most significant, but to a much lesser extent than A1, and is negligible for several impact categories. Similarly, Module A2 also has a reasonable contribution to some impact categories but a minor contribution in others.

Modules associated with end of life have a negligible contribution to the overall life cycle burdens.

Figure 4: Contribution of individual components to environmental impact categories for Acryl products



The results show that in terms of processing, the GRP spraying stage is the dominant contributor in nine out of the ten environmental impact categories. For the GWP impact category, there is a similar contribution from both moulding and spraying stages. Secondary contributions come mainly from the moulding stage, which has significant contributions in six out of the ten environmental impact categories (GWP, AP,EP marine and terrestric, POCP and ADPF). The contribution analysis for GWP and WDP show some stages with negative values. For the GWP the negative value is due to biogenic content in the packaging. Biogenic content refers to carbon sourced from plants, such as found in cardboard derived from trees. As this is a cradle to gate study, this is not balanced by emissions at end of life, where the carbon would usually be converted back to carbon dioxide and returned to the atmosphere. The Roeselare site does not utilise water in the Acryl production process, so the water depletion impacts shown relate to that used in background datasets such as in raw materials, energy etc. For the WDP, the negative value for moulding is an artefact of the characterised water flows in the background data (the net water consumption for this process is positive).

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