

ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	Röhm GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-EVO-20180023-IAD1-EN
Issue date	15.06.2018
Valid to	14.06.2023

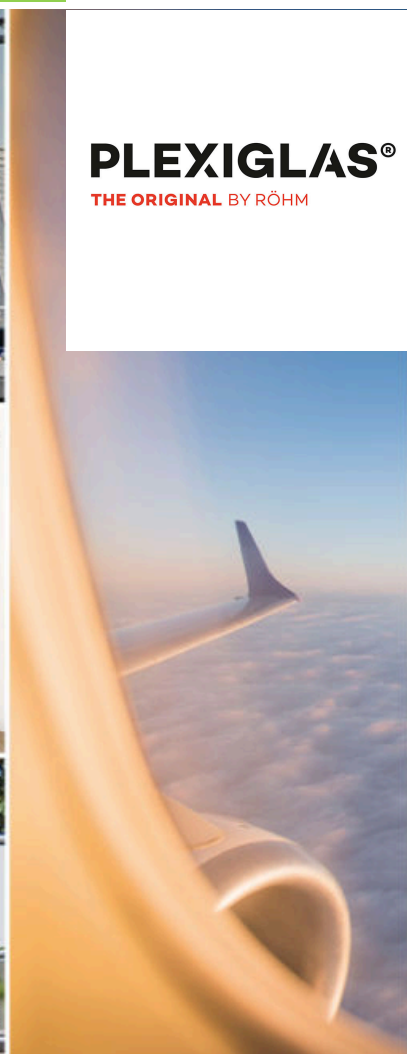
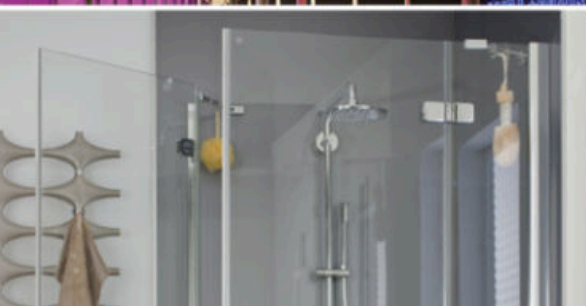
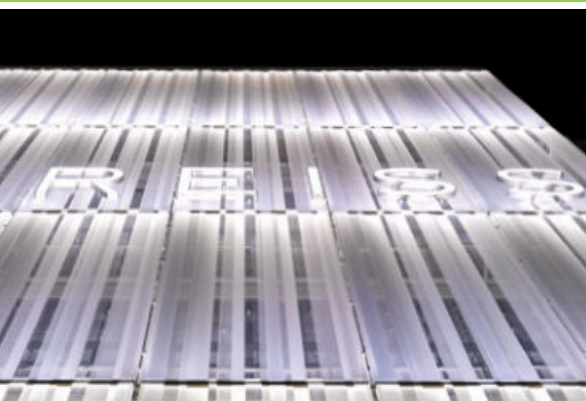
PLEXIGLAS® solid sheets

Röhm GmbH



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PLEXIGLAS®
THE ORIGINAL BY RÖHM



1. General Information

<p>Röhm GmbH</p> <hr/> <p>Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany</p> <hr/> <p>Declaration number EPD-EVO-20180023-IAD1-EN</p> <hr/> <p>This declaration is based on the product category rules: Boards and panels made of plastic (exterior applications), 11.2017 (PCR checked and approved by the SVR)</p> <hr/> <p>Issue date 15.06.2018</p> <hr/> <p>Valid to 14.06.2023</p> <hr/> <p></p> <hr/> <p>Prof. Dr.-Ing. Horst J. Bossemayer (President of Institut Bauen und Umwelt e.V.)</p> <hr/> <p></p> <hr/> <p>Dipl. Ing. Hans Peters (Head of Board IBU)</p>	<p>PLEXIGLAS® solid sheets</p> <hr/> <p>Owner of the declaration Röhm GmbH Riedbahnstraße 70 64331 Weiterstadt Deutschland</p> <hr/> <p>Declared product / declared unit This environmental product declaration describes environmental impacts for 1 kg of solid sheets of PLEXIGLAS®.</p> <hr/> <p>Scope: This environmental product declaration describes PLEXIGLAS® solid sheets from Röhm GmbH and takes into account its production sites worldwide. The environmental impacts described refer to the "cradle to gate" system limit.</p> <p>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.</p> <hr/> <p>Verification</p> <table border="1"> <tr> <td colspan="2">The standard /EN 15804/ serves as the core PCR</td> </tr> <tr> <td colspan="2">Independent verification of the declaration and data according to /ISO 14025:2010/</td> </tr> <tr> <td><input type="checkbox"/> internally</td> <td><input checked="" type="checkbox"/> externally</td> </tr> </table> <hr/> <p></p> <hr/> <p>Christina Bocher (Independent verifier appointed by SVR)</p>	The standard /EN 15804/ serves as the core PCR		Independent verification of the declaration and data according to /ISO 14025:2010/		<input type="checkbox"/> internally	<input checked="" type="checkbox"/> externally
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2. Product

2.1 Product description / Product definition

PLEXIGLAS® is a registered trademark of Röhm GmbH.

PLEXIGLAS® solid sheets are flat plane-parallel panels of colorless or colored acrylic glass, for which the chemical name is polymethyl methacrylate, abbreviated to PMMA.

A distinction is made depending on the production process, between PLEXIGLAS® GS and XT sheets. PLEXIGLAS® GS solid sheets are produced by a casting process, and PLEXIGLAS® XT solid sheets by an extrusion process (-> see also "Production").

The sheet geometry is defined by the width, length, and height (thickness) of the sheet.

Clear-transparent PLEXIGLAS® solid sheets have a distinctive property profile.

Their characteristics include:

- crystal-clear optics
- high light transmittance
- low weight
- high break resistance
- easy processability
- extraordinarily high weathering- and UV resistance

Moreover, PLEXIGLAS® solid sheets are available in various colors. Regarding light transmittance, a distinction is made between transparent (clear), translucent (light-diffusing), and opaque (light-impermeable) sheets.

The surfaces of PLEXIGLAS® sheets may be high-gloss, silk matt, or textured in other ways.

In addition to various colors and textured surfaces, PLEXIGLAS® solid sheets are available in a number of different product variants.

Typical product finishes or modifications include, for example:

- hard coating for scratch resistance
- special mixes (blends), for example to achieve defined property profiles
- surface marking

PLEXIGLAS® solid sheets have not so far been subject to EU harmonization legislation. The respective national provisions at the point of use apply for the use of PLEXIGLAS® solid sheets.

2.2 Application

PLEXIGLAS® is one of the premium-quality and most versatile plastics.

The solid sheets are used in a large number of different applications, such as

- transparent and non-transparent noise control
- aircraft and helicopter glazing
- glazing for trucks, boats, and special-purpose vehicles
- large aquariums
- industrial construction applications, e.g. facades
- the furniture industry
- interior design
- exhibition booth and shop fitting
- illuminated signage
- the lighting industry
- bathroom and wellness
- private and industrial roofing

For these varied applications, Röhm GmbH offers different product families including

- PLEXIGLAS® GS
- PLEXIGLAS® XT
- PLEXIGLAS® Soundstop
- PLEXIGLAS® Heatstop
- PLEXIGLAS® Hi-Gloss
- PLEXIGLAS® LED
- PLEXIGLAS® Optical
- PLEXIGLAS® Reflections
- PLEXIGLAS® Resist
- PLEXIGLAS® Satinice
- PLEXIGLAS® Solar
- PLEXIGLAS® Textures

Application rules / requirements

PLEXIGLAS® solid sheets are produced in accordance with /DIN ISO 7823-1/ and /DIN ISO 7823-2/. They are generally components of a system or design. Requirements on building systems or designs relating to

- mechanical strength and structural stability
- fire protection
- hygiene, health, environmental protection
- safety, accessibility
- noise control
- energy conservation, thermal insulation
- sustainable use of natural resources

depend on the application as well as the point of use of the systems and the designs.

Requirements on modern noise control in urban centers, for example, are high. As a safety factor in road traffic to protect local residents, noise protection barriers need to be functional, but they must also retain a well-maintained appearance over the long term and blend into the landscape.

PLEXIGLAS® Soundstop is an acrylic glass developed specially for use in noise protection barriers. To meet different requirements PLEXIGLAS® Soundstop is available in a number of variants, for example in XXL formats, in various thicknesses and colors, with an integrated restraint system, and with bird deterrent

markings, as well as for non-transparent glare protection and privacy screens, also in combination with transparent elements.

Whether in gigantic commercial airliners or small gliders, aviation materials have always had to meet the highest requirements. They must withstand extreme temperature changes, protect against UV radiation, and be weathering-resistant and robust—, moreover, weigh as little as possible. And the requirements on aircraft continue to be more stringent. One important aim is to reduce fuel consumption by reducing weight. PLEXIGLAS® aviation materials are helping to ensure that these developments continue to advance. PLEXIGLAS® aviation transparency glazing is therefore found in the passenger cabin windows as well as the cockpit.

Light quality, light distribution, and energy efficiency are crucial factors in modern lighting technology. PLEXIGLAS® is the ideal solution for these requirements. Its properties—transparency and brilliance, a variety of surfaces, and good formability—satisfy the technical and design requirements of lighting planners and advertisers, lighting manufacturers, and architects.

The variety of form and color, combined with intelligent functionalities and simple processing, offer infinite freedom of design in furniture making, trade-show booth construction, and shopfitting. PLEXIGLAS® is used here in displays for product presentation, as decorative elements, in wall and ceiling design, and for ambient lighting.

Mechanical engineers, property developers, vehicle manufacturers, and shopfitters are facing increasing challenges: On the one hand, protection solutions must ensure safety over the long term; on the other, their visual appearance must be appropriate to the functionality. In the ideal case the design supports safety. This is why they often rely on PLEXIGLAS®: as machine protection, for industrial components, as glazing in transportation and construction, on boards in ice hockey stadiums, and in retail security and merchandise protection.

2.3 Technical Data

Technical Data

Name	Value	Unit
Thickness according to ISO 7823	1.5-250	mm
Gross density according to ISO 1183	1190	kg/m ³
Flexural strength according to ISO 178	69 - 115	N/mm ²
Permissible material tension	5-10	N/mm ²
Modulus of elasticity according to ISO 527-2/1B/1	1800-3300	N/mm ²
Shear modulus according to ISO 537	900-1700	N/mm ²
Minimal permissible cold bending radius	150-330xThickness	mm
Airborne sound reduction (evaluated) (für 10mm)	32	dB
Transmission factor according to DIN 5036-3	0-92	%
Total energy transmittance according to DIN EN 410 (für farblos,klar)	6-85	%
Coefficient of thermal expansion	70-110	10 ⁻⁶ K ⁻¹
UV transmission	<1-90	%
Thermal conductivity according to DIN 52612	0.19	W/(mK)
Specific heat capacity	1.41-	kJ/kgK

	1.47	
Forming temperature	140-175	°C
Max. surface temperature	170-200	°C
Permanent operating temperature	70-80	°C
Reverse-forming temperature	>75->80	°C
Impact resistance Charpy, ISO 179/fu	15 - no break	kJ/m ²
Vicat softening point ISO 306, Method B 50	97-115	°C

2.4 Delivery status

PLEXIGLAS® solid sheets are available in the following standard dimensions.

- Thickness: 1.5 – 250 mm
- Widths: normally: 2030 – 2050 mm
- Lengths supplied: normally 3050 mm, customized lengths possible

All sheets are masked with surface-protection film. Depending on the depth of the distribution hierarchy, delivery may be on pallets (-> see also "Packaging") or as single items.

The design of the shipping pallets, which are generally made of wood, depends on the formats and weights of the PLEXIGLAS® sheets.

The load varies according to the format and thickness of the sheet, and is usually between 5 and 60 pieces of PLEXIGLAS® sheets or panels per pallet (normally 1000 kg gross weight).

2.5 Base materials / Ancillary materials

PLEXIGLAS® is the registered trademark of Röhm GmbH for acrylic glass (chemical name: polymethyl methacrylate, abbreviated to PMMA).

Acrylic glass is an amorphous, glassy, thermoplastic polymer obtained by polymerization of the monomeric methacrylic acid methyl ester.

The majority of the PLEXIGLAS® variants described may contain up to around 2% of added components such as fillers, pigments, etc. Acrylate or methacrylate compounds may be present in larger quantities.

According to current knowledge, PLEXIGLAS® in its basic chemical structure contains no substances that are acutely toxic, carcinogenic, mutagenic, or reprotoxic, and in this respect is not hazardous to human health or the environment.

PLEXIGLAS® solid sheets are therefore REACH compliant under Regulation /EC 1907/2006/. They do not contain in amounts > 0.1% (w/w) any Substances of Very High Concern (SVHC) as appear on the current Candidate List in accordance with Art. 59 of REACH, nor any substance listed in Annex XIV published on the ECHA website (<http://echa.europa.eu>).

2.6 Manufacture

PLEXIGLAS® GS solid sheets are produced by casting, with the liquid monomer (MMA) being filled into a shaping chamber. The chamber typically consists of two glass plates separated by a flexible sealing gasket. The height of the gasket is the major determinant of the subsequent sheet thickness. The polymerization of the monomer in the chamber into a solid sheet generally occurs by a temperature- or initiator-controlled process.

PLEXIGLAS® GS solid sheets with a textured surface are produced by the use of appropriately textured glass plates.

After polymerization is complete, the glass plates and gaskets are removed from the PLEXIGLAS® GS sheet. The cast PLEXIGLAS® GS solid sheets are then masked with protective film, cut to size, and stacked on pallets.

PLEXIGLAS® XT solid sheets are produced in an extrusion process. PLEXIGLAS® granulate or molding compound is fused in a heated steel cylinder and extruded through a forming die by means of a rotating screw conveyor in the cylinder.

The PLEXIGLAS® XT solid sheets attain their final form and surface in a subsequent calibration process, generally in a multi-roll calender. In multi-roll calendars the surface of the temperature-controlled rollers determines the sheet surface, and the roller gap of the outlet defines the thickness of the panels or sheets. After calibration the extruded PLEXIGLAS® XT solid sheets are masked with protective films, cut to size, and stacked on pallets.

2.7 Environment and health during manufacturing

Gas emissions arising during production of PLEXIGLAS® solid sheets are removed by suction and disposed of by appropriate methods, such as off-gas cleaning in biofilters or thermal aftertreatment. In normal operation only very small quantities of wastewater are generated, which are treated in an appropriate process.

Production wastes are minimized and where possible fed back into the production process (-> see also "Re-use phase").

The production of PLEXIGLAS® solid sheets is in compliance with /DIN ISO 9001/ and /14001/.

2.8 Product processing/Installation

PLEXIGLAS® solid sheets are very easily processed. They are suitable for all common methods for processing of plastics, such as:

machining, including

- sawing (separating)
- drilling
- milling

forming, including

- thermoforming
- cold curving

joining, including

- bonding
- screw unions

surface treatment, including

- polishing
- coating
- engraving
- matting

For all processing methods, the following apply: recommendations for processing of PLEXIGLAS®; the usual technical rules for the application, if available; instructions of the manufacturers of the tools and accessories for processing and fitting of PLEXIGLAS® sheets and panels.

2.9 Packaging

In general, PLEXIGLAS® solid sheets are provided with protective films applied on both sides. These serve mainly for protection against mechanical damage and soiling during transport and handling. Protective films often also have other properties that have proven valuable, particularly for solid sheets, in downstream processing, for example in the machining and forming of PLEXIGLAS®.

The type, thickness, and adhesion of the films are selected in accordance with commonly known market requirements. Care is always taken here to use the protective film that allows the widest processing latitude.

Protective films on PLEXIGLAS® are usually made of polyethylene (PE-LD) unless the product description explicitly states otherwise. As such, they are recyclable without any problem (-> see also "Disposal").

PLEXIGLAS® solid sheets are supplied on shipping pallets (-> see also "Packaging").

After leaving the production facility the PLEXIGLAS® solid sheets are order picked by dealers or fabricators. Customers can return our shipping pallets through a retrieval system established at Röhm GmbH.

2.10 Condition of use

PLEXIGLAS® solid sheets are highly scratch-resistant and are easily machined with the usual tools. Due to their chemical structure they have good resistance to dilute acids and alkalis.

The light transmittance of the clear, colorless form is higher than for mineral glass.

They are also extraordinarily UV stable and resistant to weathering and aging. The UV-protection coatings that are necessary in many plastics are therefore not needed for PLEXIGLAS® sheets or panels, for example in long-term exterior applications.

2.11 Environment and health during use

Depending on the application, very high environmental and health requirements are sometimes placed on plastics sheets and panels.

PLEXIGLAS® solid sheets satisfy such requirements. They are produced in such a way as to contain no plasticizers, heavy metal salts, or halogens, and in particular no chlorine. In their basic chemical structure, moreover, they have no nitrogen linkages, nor what are known as aromatic constituents. Additives are required only in very small amounts, if at all. According to current knowledge PLEXIGLAS®, on the basis of its chemical structure, normally releases no toxic, carcinogenic, mutagenic, or reprotoxic substances, or other substances with similar undesired effects, in relevant quantities, even above the softening temperature (in the region of 100 degrees Celsius). PLEXIGLAS® sheets do not emit ingredients to air, water, or soil.

2.12 Reference service life

The useful life of PLEXIGLAS® solid sheets is determined by the particular application.

It varies between, for example, a few days for applications in trade-show booths to several decades for applications in the construction industry with a longer period of use.

In the view of Röhm GmbH, useful lives of up to 30 years or more are possible for outdoor applications

such as noise barriers and industrial or residential roofing.

Röhm GmbH offers warranties of up to 30 years thanks to significant product properties such as light transmittance and the absence of yellowing.

PLEXIGLAS® building products can remain in use over very long periods; this avoids the remanufacturing of a product, thus conserving resources.

The "circular economy" describes how products can contribute significantly to reducing environmental load if, in addition to good recyclability (-> see also "Re-use phase"), they also remain in use for as long as possible.

In this respect PLEXIGLAS® solid sheets can make a significant contribution to the circular economy.

2.13 Extraordinary effects

Fire

PLEXIGLAS® burns almost smoke-free, in accordance with /DIN 4102/, so that visibility restriction due to smoke and fumes can be minimized. Combustion gases of PLEXIGLAS® are not acutely toxic as defined in /DIN 53436/ and are safe by the definition in this standard. This can reduce the risk of poisoning by combustion gases. The combustion gases of PLEXIGLAS® are not corrosive as defined in /DIN VDE 0482-267/. PLEXIGLAS® is easy to extinguish; in general, water suffices as the extinguishing agent. PLEXIGLAS® luminous surfaces in the roof may fuse in a fire and serve as heat and smoke vents. The fire behavior of PLEXIGLAS® solid sheets is classified under European Building Material Class E in /DIN EN 13501/.

According to /DIN EN 13501/, there is no supplementary classification of dripping behavior and smoke-gas generation for Class E building materials:

- Building material class: E
- Flaming droplets: no data
- Smoke-gas generation: no data

In Germany, they satisfy the requirements of building material class B2: normal flammability, without burning droplets.

In addition to the building material classes and fire classes, PLEXIGLAS® solid sheets satisfy fire requirements for specific applications, for example

- Resistance to brushwood fire /DIN 1794/, /ZTV-LSW 06/, Road traffic noise reducing devices
- PLEXIGLAS® GS solid sheets used for aircraft glazing comply with the requirements of the /Federal Aviation Regulation (FAR) 25.853 (a) (1) (iv) (corresponding to JAR, Part 25, paragraph 25.853 (b-2) and AITM 2003)/

Water

Due to the chemical composition of PLEXIGLAS® it does not react with water.

PLEXIGLAS® solid sheets are therefore suitable for applications in contact with water, such as

- glazing for large aquariums

- viewing windows for underwater vehicles and similar

Mechanical destruction

Due to their chemical structure, PLEXIGLAS® solid sheets are resistant to the usual mechanical influences in installation and during use.

PLEXIGLAS® Resist solid sheets have significantly higher hardness thanks to their specially modified impact resistance.

Applications with particularly demanding requirements on mechanical strength include, for example,

- transparent noise barriers (with or without splinter binding)
- (cockpit) glazing for aircraft, helicopters, etc.

2.14 Re-use phase

Due to their properties, PLEXIGLAS® solid sheets are products that are used for high-quality durable consumer goods. Their resistance to aging and weathering ensure that, even after many years of use, PLEXIGLAS® solid sheets are still fully functional and need not be prematurely replaced or exchanged. At the end of their life cycle, PLEXIGLAS® sheets, cleanly separated, can be conveyed at various recycling stages to a thermal recycling facility for energy recovery, or alternatively to physical or chemical recycling.

Recycling stages

Primary recycling

This describes the recycling loop of, e.g., PLEXIGLAS® scrap as long as the products have not yet left the production facility. Röhm GmbH has for many years been feeding all scrap generated in this way immediately into a recycling loop (physical recycling, see below); this means that PLEXIGLAS® XT solid sheets are ground, re-granulated, and re-used in specialty products.

PLEXIGLAS® GS solid sheets can be fed to chemical recycling (see below).

Secondary recycling

All PLEXIGLAS® scrap generated during processing by customers is integrated again into an appropriate loop.

Tertiary recycling

This describes the recycling of PLEXIGLAS® parts at the end of their life cycle.

The clean separation of PLEXIGLAS® solid sheet sections from other materials is crucially important in all recycling processes and stages.

Thermal recovery

Assuming suitable combustion conditions, this yields almost exclusively water (H₂O) and carbon dioxide (CO₂), and therefore no air-polluting emissions or toxic combustion gas products.

Physical recycling

After clean separation, extruded PLEXIGLAS® sheets can be collected, ground, regranulated, and re-fed into the extrusion process. This reprocessing of

PLEXIGLAS® hardly impacts any of the original properties; the products from the re-processing are therefore of the same high quality as those from virgin material.

Chemical recycling

PLEXIGLAS® can be reconverted into its original building block, monomeric methyl methacrylate, in a chemical process (cracking, or chemical depolymerization).

This monomer is then once again the starting material for new acrylic or is applied in other methacrylate applications, such as methacrylate dispersions. In our view, the chemical recycling of PLEXIGLAS® corresponds most closely to a cradle-to-cradle approach.

2.15 Disposal

If the scrap generated from PLEXIGLAS® XT solid sheet in a processing facility is clean and is collected so as to be reliably separated from PLEXIGLAS® GS solid sheets and other plastics, Röhm GmbH can directly recycle this material.

For secondary and tertiary recycling (-> see also "Re-use phase") Röhm GmbH has also entered into an agreement with specialist waste-disposal firms to connect customers' plants to a controlled recycling loop for PLEXIGLAS®.

Recycling through such a recyclable materials firm is tantamount to an already functioning return system. PLEXIGLAS® GS and XT solid sheets are not considered to be special waste.

In addition to recycling them through interregional disposal companies, they can therefore also be disposed of as domestic waste.

Labeling of PLEXIGLAS® as in /DIN 54840/ and /DIN 7728/ serves for identification and material classification.

A label of this kind must contain, in addition to the "recycling triangle", information on the product class (PMMA).

Labeling may be by stamping, permanent sticker, or printing.

For PLEXIGLAS® GS and XT solid sheets, environmental labels relating to both the PLEXIGLAS® sheets (07 PMMA) and the masking film (04 PE-LD) are printed repeatedly on the masking films.

Masking films should also be separated cleanly before collection as far as possible. If recycling of the films is not possible, these may be used in a household waste incineration facility for energy recovery or deposited in a household waste collection facility, without damage to the environment.

2.16 Further information

EC safety data sheets are available for all PLEXIGLAS® sheets and panels through the sales and distribution units of the Acrylic Products Business Line of Röhm GmbH.

Further information on PLEXIGLAS® solid sheets and applications is available at:

www.plexiglas.net

www.world-of-plexiglas.com

www.plexiglas-shop.com

3. LCA: Calculation rules

3.1 Declared Unit

For the present investigation, the production of 1 kg of PLEXIGLAS® solid sheet is considered for cast as well as extruded sheets. The mean, weighted by worldwide

production sites and amounts for the reference year 2016, was determined.

Declared Unit

Name	Value	Unit
Gross density	1190	kg/m ³
Declared unit	1	kg

3.2 System boundary

This is an EPD of the *cradle to gate* type. Modules A1, A2, and A3 were considered for calculation of the life cycle assessment:

- Module A1: Provision of the precursors
- Module A2: Transport of the precursors to the site
- Module A3: Production including packaging, provision of energy, and production processes

The raw materials are considered with the inclusion of elementary flows. The construction of production facilities and the infrastructure necessary for transport are not taken into account. Similarly, the developmental expenses for the product, and input and output streams for administration, were not considered. For input of production data, real plant data, e.g. from the central accounting system, were used.

3.3 Estimates and assumptions

Assumptions about uncontrolled emissions during production were not available and are not considered. Truck and ship transportation are assumed for the transport of crude products and intermediates. The calculations are based on the corresponding data sets of the life cycle assessment software /GaBi 7 database/ from *thinkstep*. For unknown transport distances for auxiliary and residual materials, 50 km was assumed.

3.4 Cut-off criteria

Some of the auxiliary materials recorded in the production of the methyl methacrylate (MMA)

precursor were neglected for the modeling due to the very small quantities used (totally < 0.5 % by weight).

3.5 Background data

Data from the GaBi 7 database from the company *thinkstep* were used as background data /GaBi 7/.

3.6 Data quality

The raw-material data and quantities of products and by-products come from the SAP system of Röhm GmbH sites and are therefore of high accuracy. However, raw material utilization in actual operation may vary due to load fluctuations. Some uncertainties arise from, e.g., data availability for externally procured raw materials. The values used here can, however, be considered reliable as averages over time. The data are from the reference year 2016.

For the background data, region-specific data from the database of the company *thinkstep* (GaBi 7, SP33, 2017) were used. For the cut-off criteria for the background data, see the documentation for the databases /GaBi 7/.

3.7 Period under review

The production data refer essentially to the reference year 2016 and take optional relocation of products into account. The background data were updated to reflect the latest status at the time of modeling /GaBi 7/.

3.8 Allocation

No coproducts are generated in the production of PLEXIGAS® solid sheets, so no allocation is necessary.

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.

4. LCA: Scenarios and additional technical information

The areas of use and applications of PLEXIGLAS® GS and XT solid sheets are highly diverse (-> see also "Application"); for this reason no standard scenarios can be specified here.

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = 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	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg PLEXIGLAS® solid sheets

Parameter	Unit	A1-A3
Global warming potential	[kg CO ₂ -Eq.]	4.28
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	1.13E-10
Acidification potential of land and water	[kg SO ₂ -Eq.]	7.83E-3
Eutrophication potential	[kg (PO ₄) ³⁻ -Eq.]	7.57E-4
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	9.76E-4
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.28E-6
Abiotic depletion potential for fossil resources	[MJ]	102.19

RESULTS OF THE LCA - RESOURCE USE: 1 kg PLEXIGLAS® solid sheets

Parameter	Unit	A1-A3
Renewable primary energy as energy carrier	[MJ]	5.00
Renewable primary energy resources as material utilization	[MJ]	IND
Total use of renewable primary energy resources	[MJ]	5.00
Non-renewable primary energy as energy carrier	[MJ]	103.40
Non-renewable primary energy as material utilization	[MJ]	IND
Total use of non-renewable primary energy resources	[MJ]	103.40
Use of secondary material	[kg]	IND
Use of renewable secondary fuels	[MJ]	IND
Use of non-renewable secondary fuels	[MJ]	IND
Use of net fresh water	[m ³]	28.77

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES:

1 kg PLEXIGLAS® solid sheets

Parameter	Unit	A1-A3
Hazardous waste disposed	[kg]	1.74E-4
Non-hazardous waste disposed	[kg]	0.01
Radioactive waste disposed	[kg]	5.08E-4
Components for re-use	[kg]	IND
Materials for recycling	[kg]	IND
Materials for energy recovery	[kg]	IND
Exported electrical energy	[MJ]	IND
Exported thermal energy	[MJ]	IND

6. LCA: Interpretation

The majority of the calculated environmental impacts arise from production of the raw materials used (upstream chains/ecological rucksack) (Module A1). Transport (Module A2) and production of the packaging play a subordinate role. The *gate-to-gate* environmental impacts, which are those during production (Module A3) of PLEXIGLAS® GS and XT solid sheets from MMA and PMMA, arise mainly from energy provision.

The environmental impacts of PLEXIGLAS® GS and XT solid sheets are similar: The spread for GWP₁₀₀, for

example, is about 4%. It is therefore recommended that the choice of product and the decision whether to use PLEXIGLAS® GS or XT sheets be based on functional or esthetic considerations, because the ecological impacts hardly differ.

Depending on the specific application, a further grading of the results is then possible for the customer that takes into account the period of use. The results of the present declaration can serve as a base here.

7. Requisite evidence

Information on the environment and health during the production and use of PLEXIGLAS® solid sheets is

available in the Regulatory Information for PLEXIGLAS® GS and XT (see Annex).

8. References

DIN EN ISO 178

Plastics - Determination of flexural properties (ISO 178:2010 + Amd.1:2013)

DIN EN ISO 179-1

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