TRINSEO

Trinseo Sustainable Multi-purpose Cast Acrylic Sheets:

Product Environmental Summary

Trinseo has been developing material solutions enabling more sustainable applications for over a decade and is ready to accelerate its leadership position as a material solutions provider through ambitious sustainability goals.

Connecting ideas with solutions.

trinseo.com

THREE IMPORTANT PILLARS

Trinseo strives to become the solutions provider for sustainably advantaged plastics based on three important pillars:

- **Sustainable Solutions:** an entire product portfolio of materials solutions focuses on energy usage and raw material efficiencies enabling sustainable change throughout the value chain.
- **Sustainability Culture:** environmental and social responsibility are embedded into the company culture and the corporate governance.
- **Future Solutions:** changing consumer landscape and trends will shape our future. Trinseo collaborates with its customers to develop future-oriented solutions aligned with their individual sustainability goals.

INTRODUCTION

Trinseo meets the demand for sustainably advantage materials with ALTUGLAS™ R-Life, a range of PMMA sustainable solutions including chemical, mechanical recycling as well as Bio technologies.

All of TRINSEO PMMA products that fall under the ALTUGLAS™ R-Life brand, i.e., cast sheets, resins, and compounds, are similar in that they enable customers to meet their sustainability objectives. Trinseo recently developed a sustainable cast sheet solution using an advanced chemical recycling process.

ALTUGLAS™ R-LIFE CN SHEETS

ALTUGLAS™ R-Life recycled cast sheets provide comparable performance to a virgin material:

- Optical quality (high light-transmittance)
- Low weight (50% lighter than glass)
- High weathering and UV resistance (no need for coating)
- Wide range of colors and finishing (glossy, satin)
- Easy processability (drilling, milling, bonding, thermoformability, ...)
- Adhere to ISO norm 7823-1
- The product has the potential to be recycled multiple times

ALTUGLAS™ R-Life cast sheet provides a solution to customers who seek to accomplish their sustainability goals.

APPLICATIONS

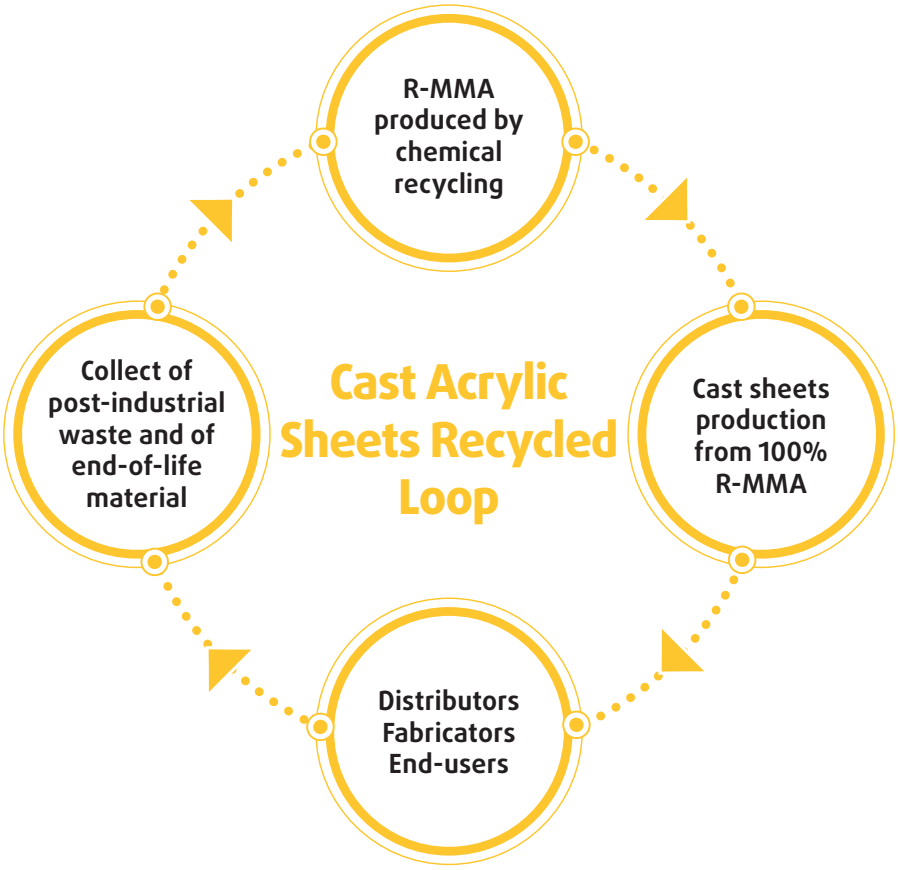
Trinseo's ALTUGLAS™ R-Life multi-purpose cast sheets can be used for a broad range of applications including:

- Retail/POS (visual communication)
- Building & Construction (esthetical & protective partitions, lighting, balustrades, sign...)
- Transportation (glazing for marine, caravanning industries...)
- Industry
- Interior Architecture/Furniture and Design

PRODUCTION PROCESS

To produce ALTUGLAS™ R-Life cast sheets in Saint-Avold (France), we rely on a standard casting process with recycled and virgin methyl methacrylate (MMA) monomer. Post-industrial waste and pre- and post-consumer end-of-life materials are depolymerized into recycled MMA monomer.

The casting process consists in filling the recycled and virgin monomers in a flat mold (two glass sheets sealed by gasket that gives thickness of the sheets) and to heat it for the monomer to polymerize. Once polymerization is completed, PMMA sheets are demolded, and a PE protective film is added.



SUSTAINABLE CONTENT DECLARATION

For ALTUGLAS™ R-Life cast sheet, Trinseo provides a sustainability content declaration of 100% of chemically recycled methyl methacrylate monomer.

ENVIRONMENTAL BENEFITS OF ALTUGLAS™ R-LIFE CAST SHEETS VERSUS VIRGIN PRODUCT

ALTUGLAS™ R-Life product portfolio offers a measurable product carbon footprint (PCF) reduction when compared to its virgin counterpart grade.

LIFE CYCLE ASSESSMENT (LCA) CALCULATION

Declared Unit of Measure

The LCA results presented here consider the production of 1 kg of Cast Acrylic Sheets containing 100% recycled MMA.

System Boundary

LCA data for the standard fossil MMA and PMMA sheets comes from the LCA study done by Bio Intelligence Services in 2013 (now Deloitte). ALTUGLAS™ R-Life Cast sheets. LCA results are consistent with the cradle-to-gate approach (from raw material extraction up to processing in manufacturing plant) for LCA calculation.

Data Sources Used and Assumptions

- Virgin LCA data comes from 2013 Bio Intelligence Services LCA report mentioned above. The LCA information remains relevant and did not require an update.
- LCA data for Recycled MMA used in the ALTUGLAS™ R-Life calculation is coming from a different supplier than the current supplier. This is because no LCA data is available yet from current supplier on Recycled MMA. Deviations are expected to be negligible. This data is from 2021.
- 1 ton MMA gives 1 ton PMMA. No material losses are considered.

LCA Estimation Method

The estimated LCA results in this document are based on the following calculation approach:

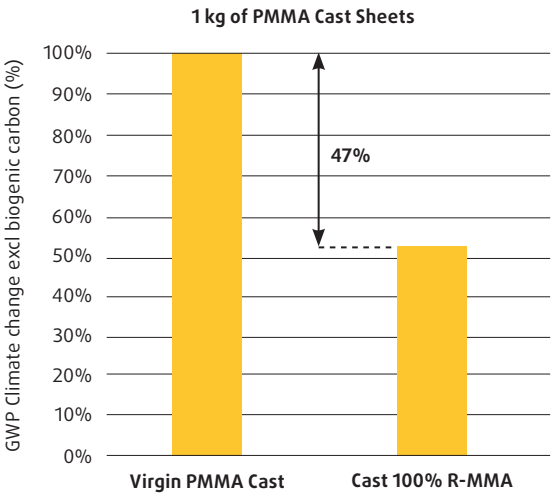
- Contribution of the virgin MMA to the total product environmental indicator in question is replaced by the corresponding KPI value of the recycled MMA or by the contribution of recycled MMA and virgin MMA in case a mixture of both is used. All selected KPI's are calculated in the same way.
- The environmental indicator units of measure from the ReciPE LCA methodology have been used. This method was selected because it is the most used method and allows for easier comparison with the virgin PMMA and MMA LCA.

Most Relevant Environmental Indicators

The definition of each of the selected environmental indicators categories, is described below:

- **GWP:** It is calculated as a sum of emissions of the greenhouse gases (CO_2, N_2O, CH_4 and VOCs) multiplied by their respective GWP factors. The different greenhouse gases are expressed relative to the global warming potential of CO_2, which is therefore defined to be 1.
- **Non-Renewable Primary Energy Use:** Use of non-renewable primary energy, excluding renewable primary energy resources used as raw materials.
- **Photochemical Oxidant Formation:** Indicator of emissions of gases that affect the creation of photochemical ozone in the lower atmosphere (smog) catalysed by sunlight.
- **Terrestrial Acidification:** Indicator of the potential acidification of soils and water due to the release of gases such as nitrogen oxides and sulphur oxides.
- **Eutrophication (Freshwater + Marine):** Indicator of the enrichment of the fresh water and marine ecosystem with nutritional elements, due to the emission of nitrogen containing compounds.

In the graph below, the impact for Global Warming Potential (GWP) is shown:



For other selected environmental indicators, the improvement (in %) when using the ALTUGLAS™ R-Life version versus the virgin version, is shown on the table below:

Environmental Indicator	
Global Warming Potential	47%
Non-Renewable Primary Energy Use	61%
Photochemical Oxidant Formation	61%
Terrestrial Acidification	75%
Eutrophication (Freshwater + Marine)	68%

The reduction in GWP when using 100% recycled MMA in the manufacturing of a PMMA cast sheet is about 47%.

Use of ALTUGLAS™ R-Life recycled cast acrylic sheets versus the virgin product can contribute to

- Acrylic Waste reduction going to landfill or incineration
- Carbon Footprint reduction
- Reduction of the production of virgin acrylic monomer
- Potential to be recycled multiple times

CONTACT US

For additional information, please contact your Trinseo representative or visit us at www.trinseo.com

trinseo.com

The principles of Responsible Care® and sustainability influence the production of printed literature for Trinseo PLC and its affiliated companies. As a contribution toward the protection of our environment, Trinseo's printed literature is produced in small quantities and on paper containing recovered/post-consumer fiber and using 100 percent soy-based ink whenever possible.

Product Stewardship

Trinseo and its affiliated companies have a fundamental concern for all who make, distribute, and use their products and for the environment in which we live. This concern is the basis for our Product Stewardship philosophy by which we assess the safety, health, and environmental information on our products so that appropriate steps may be taken to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Trinseo products – from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

Customers are responsible for reviewing their manufacturing processes and their applications of Trinseo products from the standpoint of human health and environmental quality to ensure that Trinseo products are not used in ways for which they are not suitable. Trinseo personnel are available to answer questions and to provide reasonable technical support. Trinseo product literature, including safety data sheets, should be consulted prior to the use of Trinseo products. Current safety data sheets are available from Trinseo.

No freedom from infringement of any patent owned by Trinseo or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, the customer is responsible for determining whether products and the information in this document are appropriate for the customer's use and for ensuring that the customer's workplace and disposal practices are in compliance with applicable legal requirements. Although the information herein is provided in good faith and was believed to be accurate when prepared, Trinseo assumes no obligation or liability for the information in this document.

NOTICE REGARDING MEDICAL APPLICATION RESTRICTIONS

TRINSEO REQUESTS THAT CUSTOMERS REFER TO TRINSEO'S MEDICAL APPLICATION POLICY HTTPS://WWW.TRINSEO.COM/INDUSTRIES/MEDICAL BEFORE CONSIDERING THE USE OF TRINSEO PRODUCTS IN MEDICAL APPLICATIONS. THE RESTRICTIONS AND DISCLAIMERS SET FORTH IN THAT POLICY ARE INCORPORATED BY REFERENCE.

For more information on products, innovations, expertise, and other services available from Trinseo, visit www.trinseo.com, or in the U.S. contact us at +1-855-TRINSEO (+1-855-874-6736).

DISCLAIMER

TRINSEO MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, IN THIS DOCUMENT; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE (INCLUDING MEDICAL APPLICATIONS) ARE EXPRESSLY EXCLUDED. SINCE THE CONDITIONS AND METHODS OF USE OF THE INFORMATION AND PRODUCTS REFERRED TO ARE BEYOND TRINSEO'S KNOWLEDGE AND CONTROL, TRINSEO DISCLAIMS ANY AND ALL LIABILITY FOR LOSSES OR DAMAGES THAT MAY RESULT FROM RELIANCE ON THE INFORMATION OR USE OF THE PRODUCTS DESCRIBED HEREIN. TRINSEO MAKES NO WARRANTIES, EXPRESS OR IMPLIED, THAT THE USE OF ANY TRINSEO PRODUCT WILL BE FREE FROM ANY INFRINGEMENT CLAIMS.

GENERAL NOTICE

Any photographs of end-use applications in this document represent potential end-use applications but do not necessarily represent current commercial applications, nor do they represent an endorsement by Trinseo of the actual products. Further, these photographs are for illustration purposes only and do not reflect either an endorsement or sponsorship of any other manufacturer for a specific potential end-use product or application, or for Trinseo, or for specific products manufactured by Trinseo.If products are described as "experimental" or "developmental": (1) product specifications may not be fully determined; (2) analysis of hazards and caution in handling and use are required; (3) there is greater potential for Trinseo to change specifications and/or discontinue production, and (4) although Trinseo may from time to time provide samples of such products, Trinseo is not obligated to supply or otherwise commercialize such products for any use or application whatsoever.

For additional information not covered by the content of this document or to ensure you have the latest version of this document available, please refer to our website at www.trinseo.com/Contact-Us.

Follow us at:

TRINSEO™

trinseo.com