



Eco-profiles and Environmental Product Declarations of the European Plastics Manufacturers

Aromatic Polyester Polyols (APP)

PU Europe

February 2016



Environmental Product Declaration

Introduction

This Environmental Product Declaration (EPD) is based upon life cycle inventory (LCI) data from 2014 and the GaBi database 2014 fulfilling the requirements on PlasticsEurope's Eco-profile programme. It has been prepared according to **PlasticsEurope's Eco-profiles and Environmental Declarations – LCI Methodology and PCR for Uncompounded Polymer Resins and Reactive Polymer Precursors** (PCR version 2.0, April 2011). EPDs provide environmental performance data, but no information on the economic and social aspects which would be necessary for a complete sustainability assessment. EPDs do not imply a value judgement between environmental criteria.

This EPD describes the production of aromatic polyester polyols (APP) from cradle to gate (from crude oil extraction to liquid resin at plant, i.e. APP production site output). **Please keep in mind that comparisons cannot be made on the level of the polymer material alone:** it is necessary to consider the full life cycle of an application in order to compare the performance of different materials and the effects of relevant life cycle parameters. This EPD is intended to be used by member companies, to support product-orientated environmental management; by users of plastics, as a building block of life cycle assessment (LCA) studies of individual products; and by other interested parties, as a source of life cycle information.

Meta Data

Data Owner	PU Europe aisbl
LCA Practitioner	thinkstep AG
Programme Owner	Plastics Europe aisbl
Programme Manager, Reviewer	DEKRA Assurance Services GmbH
Number of plants included in data collection	5
Representativeness	75-85%
Reference year	2014
Year of data collection and calculation	2015
Expected temporal validity	2024

Cut-offs	No significant cut-offs
Data Quality	Good
Allocation method	Price allocation (for one of the products)

Description of the Product and the Production Process

Aromatic Polyester Polyols comprises a group of products which are polymers. Therefore neither a CAS number, nor an IUPAC name, nor a chemical formula can be stated. The following products are considered:

LUPRAPHEN (BASF)
HOOPOL (Synthesia)
TERATE (Invista)
ISOEXTER 3061 (COIM)
STEPANPOL (Stepan)

Polyester Polyols are important intermediate products for many production chains. APPs are used to manufacture polyisocyanurate (PIR) and polyurethane (PUR) rigid insulation foam, which finds extensive use in the automotive, construction, refrigeration and other industrial sectors. Other uses include flexible polyurethane foams, semi-rigid foams, and polyurethane coatings. A major part of the world's polyols production is shared by two groups of polyols, namely polyether and polyester polyols.

Production Process

Aromatic polyester polyols result from the polycondensation from a variety of potential input materials such as di- or trifunctional polyols, e.g. diethylene glycol and aromatic anhydrides, e.g. phthalic anhydrides. Also the the production technology can differ from producer to producer.

The reference flow, to which all data given in this EPD refer, is 1 kg of average aromatic polyester polyols (APP).

Data Sources and Allocation

The main data source is a primary data collection from European producers of APP, providing site-

specific gate-to-gate production data for processes under operational control of the participating companies: 5 producers with 5 plants / 6 products in 4 different European countries.

This covers more than 75-85 % of a total market of more than 100,000 t of the European APP production (EU-27) in 2014.

The data for the upstream supply chain until the precursors are taken from the database of the software system GaBi 6 [GABI 6].

All relevant background data, such as energy and auxiliary materials, is from the GaBi 6 database; the documentation is publicly available [GABI 6].

Use Phase and End-of-Life Management

Due to high resistance to light and thermal aging, as well as thermal stability of polyurethane produced with APPs, the polyurethane/polyisocyanurate (PUR/PIR, in the following the common term for both PU is applied) products are used for paints, coating materials and flame-retarded rigid foams [ULLMANN 2010]. They also may be formulated into adhesives, sealants, and elastomers.

Polyurethanes are made from polyols e.g. APPs and polyisocyanates. Typical isocyanates used include polymeric methylene diphenyl diisocyanate (PMDI) in rigid foam applications. Toluene diisocyanate (TDI) is used in flexible foam applications. Monomeric MDI is used in adhesive, coating, sealant, and elastomer applications. Flame retardants may be included in the APP batch and/or added separately during PUR production. This Eco-profile refers to APP without flame retardant additions.

When used in thermal insulation products, the use phase results in substantial energy savings of buildings / technical installations / fridges over their use phase.

Today's most important process for an end-of-life is an energy recovery of the PU material.

Most of the production waste (and some installation off-cuts) is recycled.

Environmental Performance

The tables below show the environmental performance indicators associated with the production of 1 kg APP.

Input Parameters

Indicator	Unit	Value
Non-renewable energy resources ¹⁾	MJ	66.79
• Fuel energy	MJ	42.04
• Feedstock energy	MJ	24.75*
Renewable energy resources (biomass) ¹⁾	MJ	3.27
• Fuel energy	MJ	1.63
• Feedstock energy	MJ	1.64
Abiotic Depletion Potential		
• Elements	kg Sb eq	1.05E-06
• Fossil fuels	MJ	59.5
Renewable materials (biomass) (key foreground process level)	Kg	- **
Water use (key foreground process level)	kg	5.04
• for process	kg	na
• for cooling	kg	na
¹⁾ Calculated as upper heating value (UHV) na= not available – details see table 9 * since this value cannot be retrieved directly from the LCA model, it was assumed as 110% of the APP upper calorific value (assumption in accordance with several Eco-profiles since 2010) ** due to confidentiality reasons, this value cannot be communicated		

Output Parameters

Indicator	Unit	Value
GWP	kg CO ₂ eq	1.82
ODP	g CFC-11 eq	2.22E-07
AP	g SO ₂ eq	5.59
POCP	g Ethene eq	2.04
EP	g PO ₄ eq	1.10
Dust/particulate matter PM10 ²⁾	g PM10	1,87E-01
Total particulate matter ²⁾	g	2.49E-01
Waste		
• Radioactive waste	kg	9.16E-04
• Non-radioactive waste ³⁾	kg	3.23E-02
²⁾ Including secondary PM10 ³⁾ Non-radioactive wastes include: spoil, tailings, and waste, deposited		

Additional Environmental and Health Information

Not available

Additional Technical Information

The incorporated aromatic acid provides thermal stability which allows the rigid foam to pass typical building code flammability tests. The aromatic acid also provides hydrolysis resistance to the final product.

Regarding flame retardant, from the existing APP Eco-profile (results from study published in 2010)

only the dataset without flame retardant is updated and presented here. Many application areas of APP require different amounts of flame retardant. Hence, the respective amounts (including its potential environmental burdens) need to be added afterwards anyways. The input of flame retardant (including its potential environmental burdens) can be easily added afterwards since it is physically mixed and does not require a chemical linkage.

Additional Economic Information

When used in thermal insulation products, APP enables substantial energy savings of buildings / technical installations / fridges over their use phase.

Information

Data Owner

PU Europe

Avenue E van Nieuwenhuyse 6

B-1160 Brussels, Belgium

Tel.: +32 (2) 676 73 52

Fax: +32 (2) 676 74 79

E-mail: secretariat@pu-europe.eu

Programme Manager & Reviewer

DEKRA Assurance Service GmbH

This Environmental Product Declaration has been reviewed by DEKRA Assurance Service GmbH. It was approved according to the Product Category Rules PCR version 2.0 (2011-04) and ISO 14025:2006.

Registration number: PlasticsEurope 2016-001
validation expires on 31 January 2019 (date of next revalidation review).

Programme Owner

PlasticsEurope

Avenue E van Nieuwenhuyse 4, Box 3

B-1160 Brussels, Belgium

Tel.: +32 (2) 675 32 97, Fax: +32 (2) 675 39 35

E-mail: info@plasticseurope.org.

For copies of this EPD, for the underlying LCI data (Eco-profile); and for additional information, please refer to <http://www.plasticseurope.org/>.

References

PlasticsEurope: Eco-profiles and environmental declarations – LCI methodology and PCR for uncompounded polymer resins and reactive polymer precursors (version 2.0, April 2011).