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

Styrene Acrylonitrile (SAN) and Acrylonitrile Butadiene Styrene (ABS)

PlasticsEurope
February 2015

PlasticsEurope
Association of Plastics Manufacturers

Table of Content

Environmental Product Declaration

Introduction

This Environmental Product Declaration (EPD) is based upon life cycle inventory (LCI) data from the GaBi database 2013 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 judgment between environmental criteria.

This EPD describes the production of Styrene Acrylonitrile (SAN) and Acrylonitrile Butadiene Styrene (ABS) from cradle to gate (from crude oil extraction to granules or resin at plant, i.e. SAN and ABS production site output). **Please keep in mind that comparisons <u>cannot</u> 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	PlasticsEurope aisbl
LCA Practitioner	PE INTERNATIONAL AG
Programme Owner	PlasticsEurope aisbl
Programme Manager, Reviewer	DEKRA Assurance Services GmbH
Number of plants included in data collection	5 (SAN/AMSAN) 5 (ABS)
Representativeness	90%
Reference year	2013
Year of data collection and calculation	2014
Expected temporal validity	2023
Cut-offs	No significant cut-offs
Data Quality	Good
Allocation method	None

Description of the Product and the Production Process

Styrene Acrylonitrile (SAN) is a co-polymer with statistical repetition of styrene and acrylonitrile units in the polymer chain. The described average product comes from materials with about 75% styrene and 25% acrylonitrile (in mass%). A variant using Alpha Methyl Styrene (AMS) as a monomer also exists: AMSAN. This material is included in the average calculation[1].

Acrylonitrile Butadiene Styrene (ABS) is a thermoplastic 2 phase-polymer. The proportions of the monomer components can vary. This Eco-profile covers an average of product compositions of about 45-65% styrene, 15-20% acrylonitrile and 10-25% butadiene (in mass%).

The co-polymerisation of styrene with further monomers leads to materials which show advantages compared to polystyrene with regard to hardness, strength, resistance to heat distortion and environmental stress cracking.

Production Process

For the production of SAN/AMSAN, suspension and continuous bulk technologies are applied; ABS is produced by emulsion polymerisation, bulk polymerisation or combined processes. The type of production technology influences the material's properties. While Mass ABS process is mainly used

[1] Comparing the (confidential) foreground data for AMSAN and SAN regarding energy demand and the overall results of the main impact categories, both production routes do not show significant differences outside the range of variation of all single results.

for General purpose ABS applications with excellence flow/hardness performance, emulsion polymerization is preferred to produce ABS products with high gloss and toughness requirements. The full range of ABS properties for injection molding and extrusion processing is available when products made by different technologies are mixed in compounding.

The reference flows, to which all data given in this EPD refer, are 1 kg SAN/AMSAN granulates and 1 kg of ABS granulates, respectively.

Data Sources and Allocation

The main data source is a primary data collection from European producers of SAN/AMSAN and ABS, providing site-specific gate-to-gate production data for processes under operational control of the four participating companies.

Each participant of the study delivered data for SAN and ABS production. Overall four sites for SAN production, one for AMSAN and five sites for ABS production are included in the average calculations.

This covers more than 90 % of the European SAN and ABS production (EU-27) in 2013, respectively. The data for the precursors upstream supply chain (styrene, alpha-methyl styrene, acrylonitrile and butadiene) are taken from the database of the software system GaBi 6 [GABI 6]. A mix of two different routes for the production of styrene (EBSM and POSM) is modelled. 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

SAN is marketed for a range of applications such as cookware, transparent parts in electronics and electrical appliances, instrument panels, sanitary and medical goods or cosmetic packaging. SAN can also be used as the rigid component for ABS manufacturing. AMSAN is used as a modifier for increasing the heat resistance of ABS and PVC.

Due to its combination of strength and impact resistance, ABS is widely used as an engineering material. The main consumers are the automotive industry, the domestic appliances industry, the data technology and telecommunications area, and producers of refrigeration equipment, toys, sports articles, and semi-finished articles.

SAN and ABS can be recycled, used articles can be ground and directly recycled in the production process. Furthermore, energy recovery by incineration is also possible.

Environmental Performance

The tables below show the environmental performance indicators associated with the production of 1 kg SAN and 1 kg of ABS.

Input Parameters

Indicator	Unit	Value	
		SAN	ABS
Non-renewable energy resources[1)]	MJ	91.61	90.57
• Fuel energy	MJ	48.21	47.34
• Feedstock energy	MJ	43.40	43.23
Renewable energy resources (biomass)[1)]	MJ	1.27	1.61
• Fuel energy	MJ	0.67	0.84
• Feedstock energy	MJ	0.60	0.77
Abiotic Depletion Potential			
• Elements	kg Sb eq	8.87E-07	1,48E-06
• Fossil fuels	MJ	82.93	81,37
Renewable materials (biomass)	kg	-	-
Water use (key foreground process level)	kg	21.76	22.03
• for process	kg	na	na
• for cooling	kg	na	na

[1)] Calculated as upper heating value (UHV)
na= not available – details see table 17/18

Output Parameters

Indicator	Unit	Value	
		SAN	ABS
GWP	kg CO_2 eq	2.96	3.10
ODP	g CFC-11 eq	8.32E-08	2.60E-07
AP	g SO_2 eq	8.04	7.69
POCP	g Ethene eq	1.19	1.09
EP	g PO_4 eq	1.02	1.03
Dust/particulate matter[2)]	g PM10	1,37E-04	2,35E-04
Total particulate matter[2)]	g	2,13E-01	2.39E-01
Waste			
• Radioactive waste	kg	6.15E-04	8.58E-04
• Non-radioactive waste[3)]	kg	1.98E-02	2.86E-02

[2)] Including secondary PM10
[3)] Non-radioactive wastes include: spoil, tailings, and waste, deposited

Additional Environmental and Health Information

SAN and ABS can be safely used in toy and medical appliances manufacturing as well as for food processing applications.

Additional Technical Information

Chemical resistance, mechanical strength and transparency are the main properties of SAN. In addition, AMSAN offers a higher heat resistance.
For ABS, the polybutadiene rubber inclusions in the polymer matrix provide enhanced mechanical properties, such as toughness and impact resistance. Due to high stiffness and low density, all articles made from SAN/AMSAN and ABS have excellent strength-to-weight ratio.

Additional Economic Information

The technical properties chemical and impact resistance and strength for ABS and SAN enables the application in many areas. Weight reduction offers improvement potentials in applications for e.g. automotive parts, household appliances or safety helmets.

Information

Data 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.

Programme Manager & Reviewer
DEKRA Assurance Services GmbH
This Environmental Product Declaration has been reviewed by DEKRA Assurance Services GmbH. It was approved according to the Product Category Rules PCR version 2.0 (2011-04) and ISO 14025:2006.
Registration number: PlasticsEurope 2015-003, validation expires on 31 December 2017 (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).

Plastics
The Material for the 21st Century