



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

Expandable Polystyrene (EPS)

PlasticsEurope
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PlasticsEurope
Association of Plastics Manufacturers

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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 expandable polystyrene from cradle to gate (from crude oil extraction to beads at plant, i.e. EPS 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	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	4 for grey material 13 for white material (summed up in 10 sets of data collections)
Representativeness	80%
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

Expandable Polystyrene (EPS) is a polymer produced in the form of beads containing polystyrene, pentane as a blowing agent (up to 7 mass%) and possibly flame retardant.

It exists in two forms: White EPS beads, and grey EPS beads that contain carbon for improved insulation properties. Beads are further processed into expanded polystyrene, a lightweight, rigid, insulating material used to make foam blocks and molded parts.

Production Process

Expandable Polystyrene (EPS) is produced by polymerisation of styrene monomer, a chain-growth reaction which is mostly initiated by free radical organic initiators. EPS beads are produced by suspension polymerisation, extrusion or mass pelletisation.

The reference flow, to which all data given in this EPD refer, is 1 kg of average EPS beads (including white and grey material).

Data Sources and Allocation

The main data source is a primary data collection from European producers of white and grey EPS beads, providing site-specific gate-to-gate production data for processes under operational control of the participating companies: ten white EPS beads producers with thirteen plants in nine different European countries; four grey EPS producers with four plants in four European countries.

This covers more than 80 % of the European white and grey EPS beads production (EU-27) in 2013, respectively.

The data for the upstream supply chain until the precursors (styrene) 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

EPS beads are foamed in order to manufacture lightweight industrial and food packaging, insulation boards for construction, safety and sporting equipment, flotation devices, seed trays, geofoam etc. The building and construction sector is the main market and accounts for around 70% of the European EPS market.

Polystyrene, without the flame retardant HBCD, can be reused directly as new packaging, or ground for reuse as soil conditioner or in light concrete blocks; it can also be recycled in new PS-based products; furthermore, energy recovery by incineration is also possible for all types of EPS.

Environmental Performance

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

Input Parameters

Indicator	Unit	Value
Non-renewable energy resources ¹⁾	MJ	84.60
• Fuel energy	MJ	41.11
• Feedstock energy	MJ	43.49
Renewable energy resources (biomass) ¹⁾	MJ	0.99
• Fuel energy	MJ	0.48
• Feedstock energy	MJ	0.51
Abiotic Depletion Potential		
• Elements	kg Sb eq	1.30E-06
• Fossil fuels	MJ	76.59
Renewable materials (biomass)	kg	-
Water use (key foreground process level)	kg	16.72
• for process	kg	na
• for cooling	kg	na
¹⁾ Calculated as upper heating value (UHV) na= not available – details see table 9		

Output Parameters

Indicator	Unit	Value
GWP	kg CO ₂ eq	2.37
ODP	g CFC-11 eq	1.84E-07
AP	g SO ₂ eq	6.46
POCP	g Ethene eq	1.21

EP	g PO ₄ eq	0.57
Dust/particulate matter ²⁾	g PM10	2.90E-04
Total particulate matter ²⁾	g	2.28E-01
Waste		
• Radioactive waste	kg	6.06E-04
• Non-radioactive waste ³⁾	kg	4.84E-02
²⁾ Including secondary PM10		
³⁾ Non-radioactive wastes include: spoil, tailings, and waste, deposited		

Additional Environmental and Health Information

Non Flame Retardant Expandable Polystyrene can be safely used for food packaging applications.

With the development of the knowledge on the impact on health and environment of chemical substances, it was understood that HBCD, the flame retardant additive used for many years where needed to ensure the fire safety of the end uses of the expanded polystyrene applications, has PBT (Persistent, Bio accumulative and Toxic) properties according to the criteria set by the European law on the classification of chemical substances (REACH). Recently, within the UNEP (UN Environment Programme) Stockholm Convention, it was decided to classify HBCD as a POP (Persistent Organic Pollutant). Both regulatory frameworks target for such kind of chemicals for phase-out.

When the properties of HBCD began to be better understood, the EPS industry, following the Responsible Care principles, jointly began a search for safer and viable alternatives. Such new additives, safe for health and environment, can now replace HBCD.

The switch to the new flame retardant alternatives for HBCD is already initiated and partly realised. The members of the European industry of EPS are fully committed to complete swiftly such change as soon as technically viable considering all the boundaries in place such as product certification, additive availability, such that in some cases the change-over might be feasible and implemented before the phase out date. Industry has a continuous liaising with all relevant authorities to ensure that there will a smooth transition within the regulatory framework.

Additional Technical Information

The outstanding quality of expandable polystyrene lies in its performance (strength, thermal insulation,...) to weight ratio. It is also a versatile and easy to process material. Furthermore, grey EPS offers enhanced insulation properties.

Additional Economic Information

Expandable Polystyrene can be processed to very low densities – once expanded, it actually consists of 98% air and 2% polystyrene, which allows reduction of packaging weight, non-renewable resource savings, reduction of packaged goods transportation costs.

Building insulation using polystyrene foam boards enables energy savings within one year which exceed the energy used to manufacture the insulation products, but which last more than 50 years.

Information

Data Owner

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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 2015-002, validation expires on 31 December 2017 (date of next revalidation review).

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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).