

# Decontamination of hazardous substances

Special Publication

# 2021



European  
Decontamination  
Institute



**Mr. Lein Tange**  
Director



**Mr. Jan Noordegraaf**  
Director



**Ms. Alix Reichenecker**  
Circular Economy Manager

## Solution for PS-foam waste containing HBCD

In Europe every year 1,600,000 tons of polystyrene (PS) foam insulation products are installed [1]. At the same time in 2020 almost 155,000 tons PS-foam waste was generated in Europe during the demolition of buildings, a tonnage which is expected to increase in the future [2]. This is an urban mine containing resources that need to be treated in a way that allows keeping the value in the economic loop.

PS foam demolition waste generated today is likely to contain the flame retardant Hexabromocyclododecane (HBCD), which was used since the 1960s to meet national fire regulations in PS foam. Since August 2015, use of HBCD is prohibited [3] as it is classified as Persistent Organic Pollutant (POP) [4]. In expanded and extruded polystyrene (EPS and XPS), HBCD has been used in ranges between 1,000-9,000 mg/kg and 6,000-14,000 mg/kg respectively. This means that PS-foam waste containing HBCD does not exceed the limit concentration of 30,000 mg/kg and is therefore not a hazardous waste [5]. DEKRA conducted an occupational exposure study during the demolition and the pre-treatment of EPS containing HBCD and confirmed that emissions were well-below the threshold limits [6]. No additional safety measures are therefore needed when working with PS-foam waste containing HBCD. For PS-foam waste with concentrations  $\geq 1,000$  mg/kg HBCD, the Best Available Technology (BAT) according to the Basel Technical Guidelines is physical-chemical treatment (D9) as offered by PolyStyreneLoop [7].

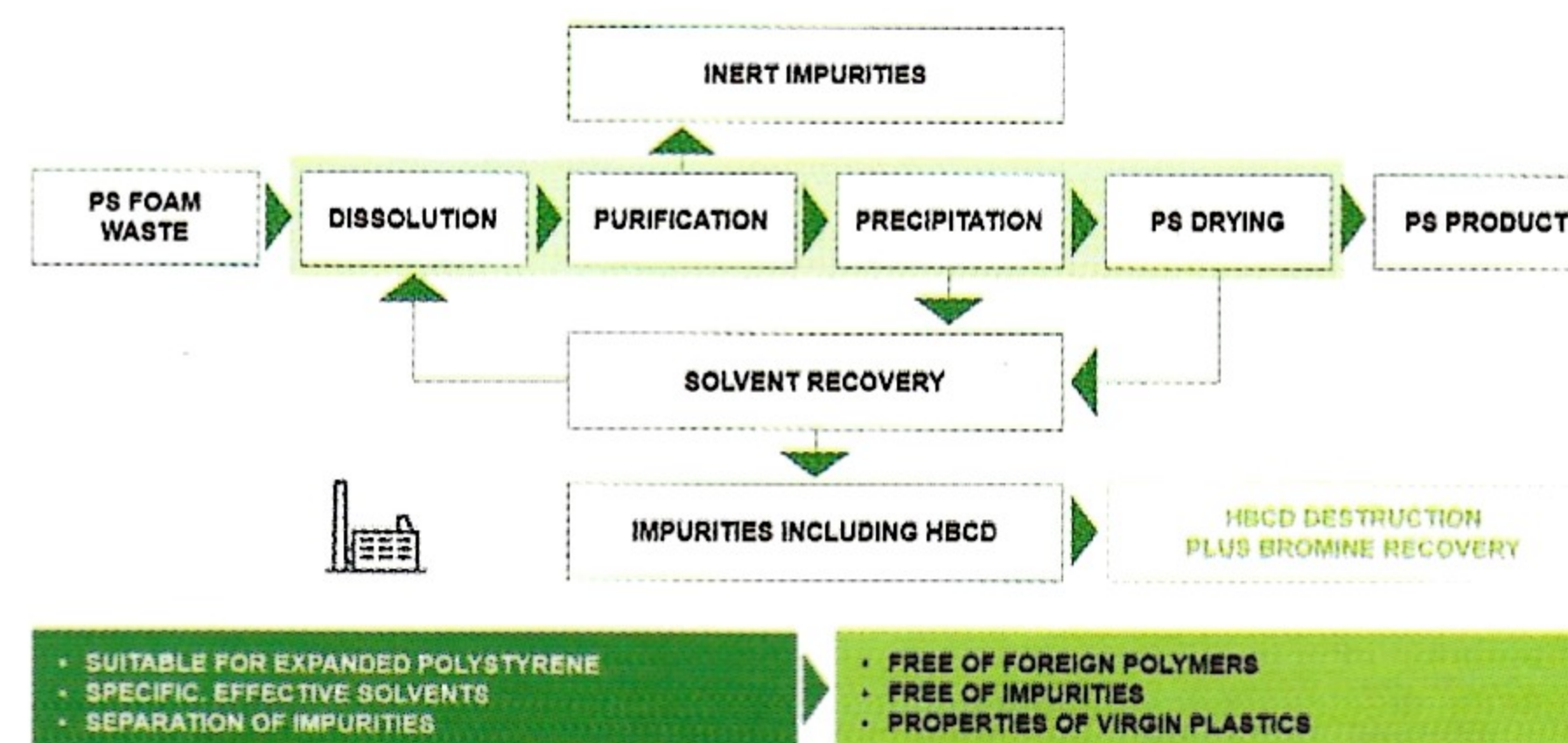


Figure 1: The PolyStyreneLoop Technology - CreaSolv® Process and Bromine Recovery Unit (BRU)

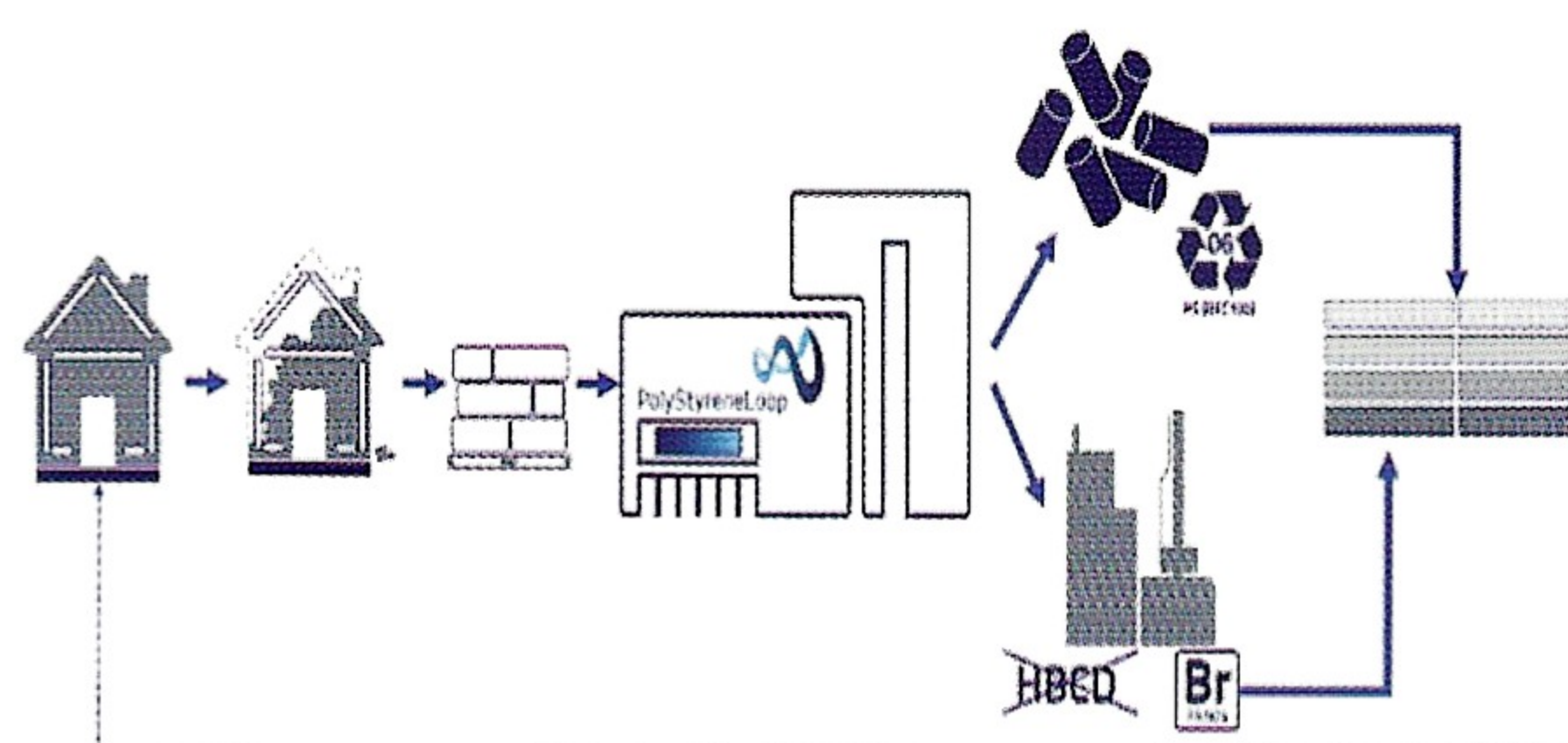


Figure 2: Closing the loops - from demolition to production of new insulation material

PolyStyreneLoop (PSLoop) is based on the CreaSolv® Technology, a Solvent-based Purification process allowing the recovery of the polystyrene through the removal of HBCD (see figure 1). In a first step, PS-foam is dissolved and impurities are filtered out. The process allows for 10% (m/m) of impurities. Through the addition of a second solvent, the HBCD is washed out and the polystyrene transforms into a gel. The safe destruction of the HBCD is carried

out in the adjacent Bromine Recovery Unit (BRU) of ICL. The BRU is a high temperature waste incinerator allowing the recovery of the bromine in the HBCD. This bromine is used for the production of modern flame retardants. The polystyrene gel is further dried and extruded into Loop-PS recycle. Through this physical recycling process, the molecular structure of the polystyrene stays unchanged. Loop-PS has the same properties as virgin material and is used to produce new insulation foams.

PolyStyreneLoop closes the polystyrene and bromine loop through the recovery of > 99% of the polystyrene foam (see figure 2). This is the world's first all-electric recovery plant using solely wind energy. The clever use of heat exchange, gravitational forces and maximum recovery of the solvent add to the sustainability of the process. PolyStyreneLoop has a yearly capacity of 3,300 tons of PS-foam waste with an output of 3,000 tons Loop-PS. The plant is located in Terneuzen, the Netherlands and will be operational as of June 2021 (see figure 3).

## References

- [1] EUMEPS (2018, September 24). EUMEPS EU Voluntary Pledge. Retrieved from: [https://eumeps.org/content/8-news/eumeps-submitted-voluntary-pledge/20180914\\_the-eumeps-voluntary-pledge.pdf](https://eumeps.org/content/8-news/eumeps-submitted-voluntary-pledge/20180914_the-eumeps-voluntary-pledge.pdf)
- [2] Post-Consumer Waste Generation and Management in European Countries 2017 - EPS Packaging Waste & EPS Construction Waste. Conversio, 2018.
- [3] Corrigendum to Commission Regulation (EU) No 143/2011 of 17 February 2011 amending Annex XIV to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals ('REACH'). OJ L 49, 24.2.2011, p. 52-53.
- [4] Listing of hexabromocyclododecane. Stockholm Convention COP6, UNEP-POPS-COP.6-SC-6-13, 2013.
- [5] Regulation (EC) No 1357/2014 of 18 December 2014 replacing Annex III to Directive 2008/98/EC of the European Parliament and of the Council on the waste and replacing certain Directives.
- [6] DEKRA (2019, November 29). Ermitteln und Beurteilen der Gefährdung bei Tätigkeiten mit Gefahrstoffen: Inhalative Exposition.
- [7] General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants: proposed methods for the management of polystyrene foam waste with HBCD. Open-ended Working Group of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, UNEP/CHW/POP-SIWG.2/3/Add.1, 2017.



The EDI Special Publication 2021 was produced with the generous support of the following companies.

The EDI Board of Directors would like to thank them, on behalf of the industry, for their cooperation and sponsorship.



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☎ (+32) 280 827 60

✉ [info@decontaminationinstitute.org](mailto:info@decontaminationinstitute.org)

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The European Decontamination Industry Report 2021, whose surveys have already been completed by decontamination professionals across Europe, will be presented next September.

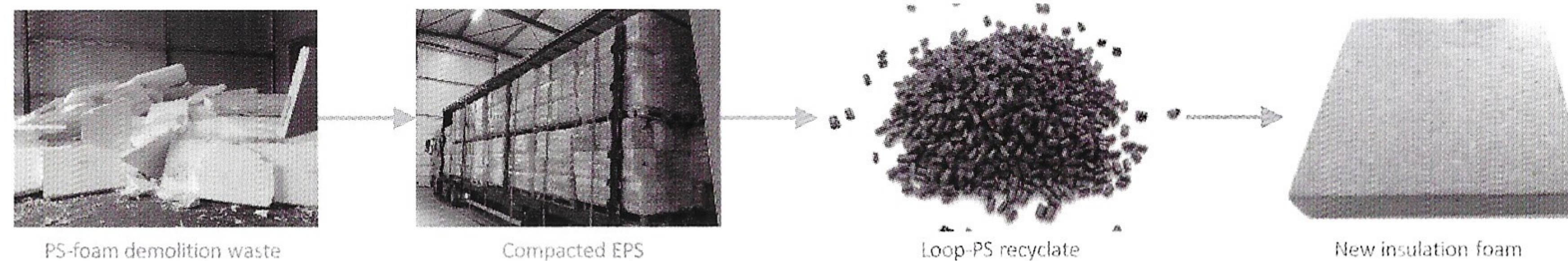
This study will be available online. In the meantime, the European Decontamination Industry Report 2020, the previous edition, is also available online.



More information of the European Decontamination Industry Report

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## Circular Economy for HBCD-containing PS-foam waste



### PolyStyreneLoop

PolyStyreneLoop is a cooperative of over 70+ members and supporters of the entire polystyrene (PS) foam value chain across Europe. The first plant for recycling of HBCD-containing PS-foam demolition waste will be operational in the Netherlands as of June 2021.

The physical recycling process allows for the removal of impurities and the washing out of the flame retardant HBCD from the PS-foam (EPS and XPS). Our Loop-PS recyclate with same properties as virgin material is used to produce new insulation boards.

### Contact



Ms. Alix Reichenecker  
 Circular Economy Manager  
 +31 6 48 110 773  
[areichenecker@polystyreneloop.eu](mailto:areichenecker@polystyreneloop.eu)

### Membership

In order to supply directly to PolyStyreneLoop membership to the cooperative is required.

### Economics example

	EPS and XPS with HBCD	XPS with HBCD + (H)CFCs <sup>1</sup>
Euralcode	17 06 04	17 06 03*
<b>Incineration costs (€/t)</b>	-€ 1.000,00	-€ 3.000,00
Pre-treatment (€/t)	-€ 500,00	-€ 50,00
Transport (500 km) (€/t)	-€ 100,00	-€ 400,00
Gatefee DDP PSLoop (€/t)	€ -	-€ 500,00
<b>Total costs supply PSLoop (€/t)</b>	-€ 600,00	-€ 950,00
<b>Savings supply PSLoop (€/t)</b>	€ 400,00	€ 2.050,00

<sup>1</sup> XPS before 2002 may contain (H)CFCs and therefore classified as hazardous waste. PSLoop has the possibility to release and capture the gases in a safe environment before further treatment. For this XPS plates need to be supplied uncompacted to PSLoop.