PolyStyreneLoop – The circular economy in action

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PolyStyreneLoop is building the first demonstration plant worldwide to treat PS-foam demolition waste containing HBCD (see figure 1). The innovative physical-chemical treatment technology on which PolyStyreneLoop is based allows the safe destruction of HBCD and the recovery of elemental bromine and polystyrene to keep these valuable resources in the loop.

Figure 1: The PolyStyreneLoop demonstration plant

Polystyrene (PS) foam insulation material ensures energy savings in the built environment through optimal climate control. Due to their outstanding properties, expanded polystyrene (EPS) and extruded polystyrene (XPS) are among the most widely used insulation materials. To meet national fire regulations, Hexabromocyclodecane (HBCD) has been used in many European countries since the 1960s as flame retardant in EPS and XPS construction products. In 2013 HBCD was brought under the Stockholm Convention regime due to its persistent, bio-accumulative and toxic properties as well as its potential for long-range transport and listed as a Persistent Organic Pollutant (POP) [1]. The provisions of the Stockholm Convention are in Europe implemented in Regulation (EC) No 850/2004 [2] and its amendments [3], [4]. Under the European REACH regulation, the putting on the market or use of HBCD was prohibited after 21 August 2015 [5]. Today the new polymeric flame retardant (pFR) has mostly replaced HBCD. In the Basel Convention Technical Guidelines, the prescribed treatment for PS foam waste with concentrations ≥ 1,000 mg/kg HBCD is either incineration or physical-chemical treatment, which was classified as Best Available Technology (BAT) [6].

In Europe every year 1,600 kt of PS foam insulation products are installed [7] while at the same time 98,6 kt PS-foam waste is generated during the demolition of buildings [8]. This is

an urban mine containing resources that need to be treated in a way that allows keeping the value in the economic loop. As the majority of the buildings demolished or refurbished today were built before 2015, all the PS-foam demolition waste generated is likely to contain HBCD. The innovative physical-chemical CreaSolv® Process on which PolyStyreneLoop (PSLoop) is based, allows the recovery of both polystyrene and elemental bromine as well as the safe destruction of HBCD (see figure 2):

1. The PS-foam waste is dissolved in a tank that contain a PS-specific solvent. Solid impurities are separated using filtration and are subsequently incinerated.

2. The introduction of a second solvent converts the PS into a gel, while the HBCD additive remains in the liquid. The PS gel is then separated from the liquid, dried and transferred into granulated polymer. The solvent in the remaining liquid is distilled and re-used in a closed loop. The HBCD additive remains as sludge.

3. The HBCD additive in the sludge is destructed using high-temperature waste incineration. During the last step, a Bromine Recovery Unit (BRU) shall recover the elemental bromine.

The Process is not sensitive to impurities of incoming material. The impurity level of the incoming PS-foam demolition waste should however not exceed 7% by weight. Furthermore, water content is to be limited to a maximum 3% by weight and bituminous impurities excluded.

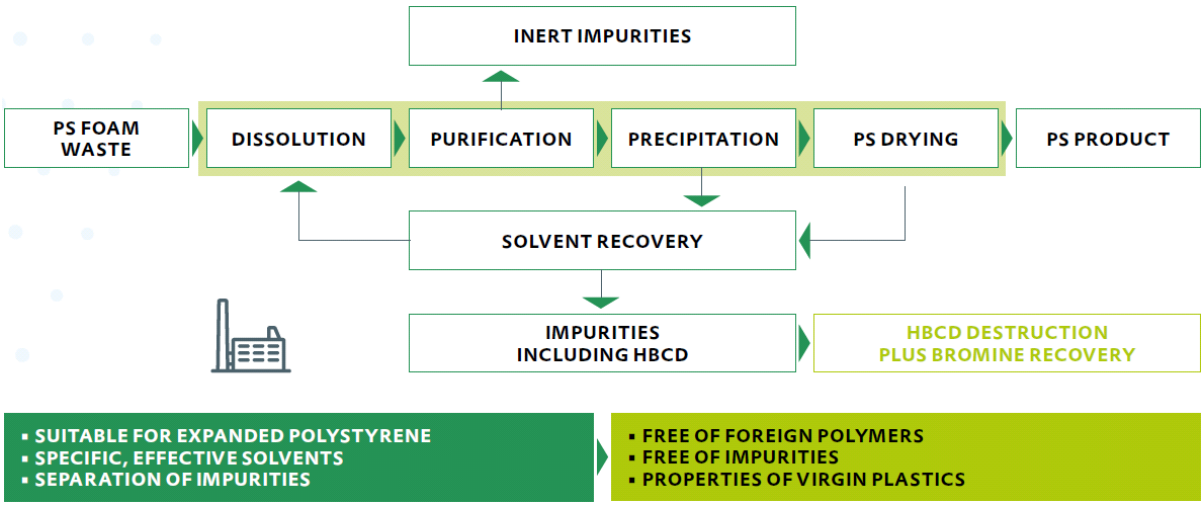

Figure 2: The PolyStyreneLoop Technology – CreaSolv® Process and Bromine Recovery Unit (BRU)

The innovation of PolyStyreneLoop does not only lie in the technology that is used but also on the organisation. PolyStyreneLoop is a cooperative with over 75 members and supporters of

the entire PS-foam value chain spanning across 18 European countries. Via the members the supply of feedstock for the plant as well as the off-take of the PS recyclate is secured, making this a robust business case that due to the vast amount of PS-foam demolition waste generated is also scalable. The elemental bromine is used to produce new pFR and together with the PS, with the same properties as virgin material, new insulation material such as extruded EPS (X-EPS) and XPS are produced and thereby closing the loops (see figure 3).

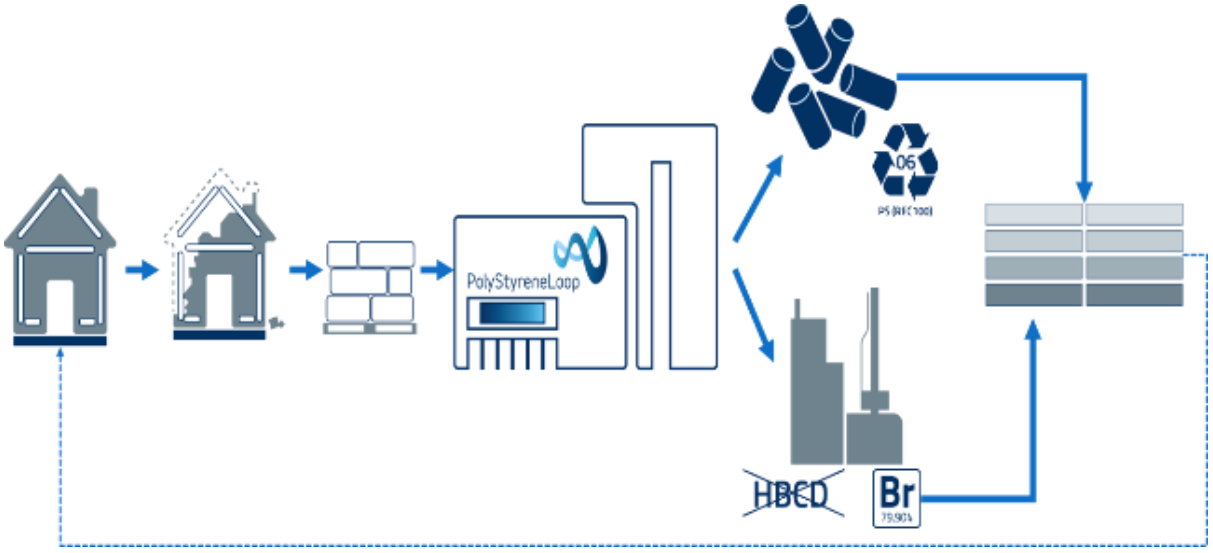

Figure 3: Closing the loops - from demolition to production of new insulation material

End 2019 the spade went into the ground for the construction of the first PolyStyreneLoop demonstration plant in Terneuzen, the Netherlands (see figure 4). The plant is located right next to the only BRU in Europe, owned by ICL-IP. The demonstration plant with a capacity of 3,300 t of PS-foam demolition waste will be built in the course of 2020 and operation in Q1 2021.

Figure 4: First spade in the ground on 16 December 2019 by Toine Janssen (Plant Manager PSLoop), Saskia Goole (Site-Manager ICL-IP), Lein Tange (Director PSLoop)

References

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[6] *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.

[7] EUMEPS EU Voluntary Pledge. EUMEPS, 2018.

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