

Results of a Life Cycle Assessment for End of Life Treatment of Expandable Polystyrene (EPS) from External Thermal Insulation Composite Systems (ETICS)

The PolyStyreneLoop (PSLoop) cooperation has been founded in order to build and run a pilot plant for the recycling of polystyrene foam. For this plant the CreaSolv® Process will be used, in which the polystyrene foam is dissolved in a suitable solvent and then precipitated. The process allows separation of the flame retardant Hexabromcyclododecan (HBCDD) which then can be destroyed in a high temperature incinerator including an attached bromine recovery unit where the bromine is recovered. This process offers a unique opportunity to recycle polystyrene foam containing HBCDD where the polystyrene AND the bromine loop is closed as part of a circular economy.

On behalf of the consortium a Life Cycle Analysis (LCA) was conducted by TÜV Rheinland in cooperation with BASF. The target is to provide an assessment on the influence of different end of life options for External Thermal Insulation Composite System (ETICS) containing EPS with flame retardant HBCDD on potential environmental aspects. Within this study incineration with energy recovery of ETICS and the PSLoop process are compared to each other using the LCA methodology according to the ISO 14040 and 14044 standards.

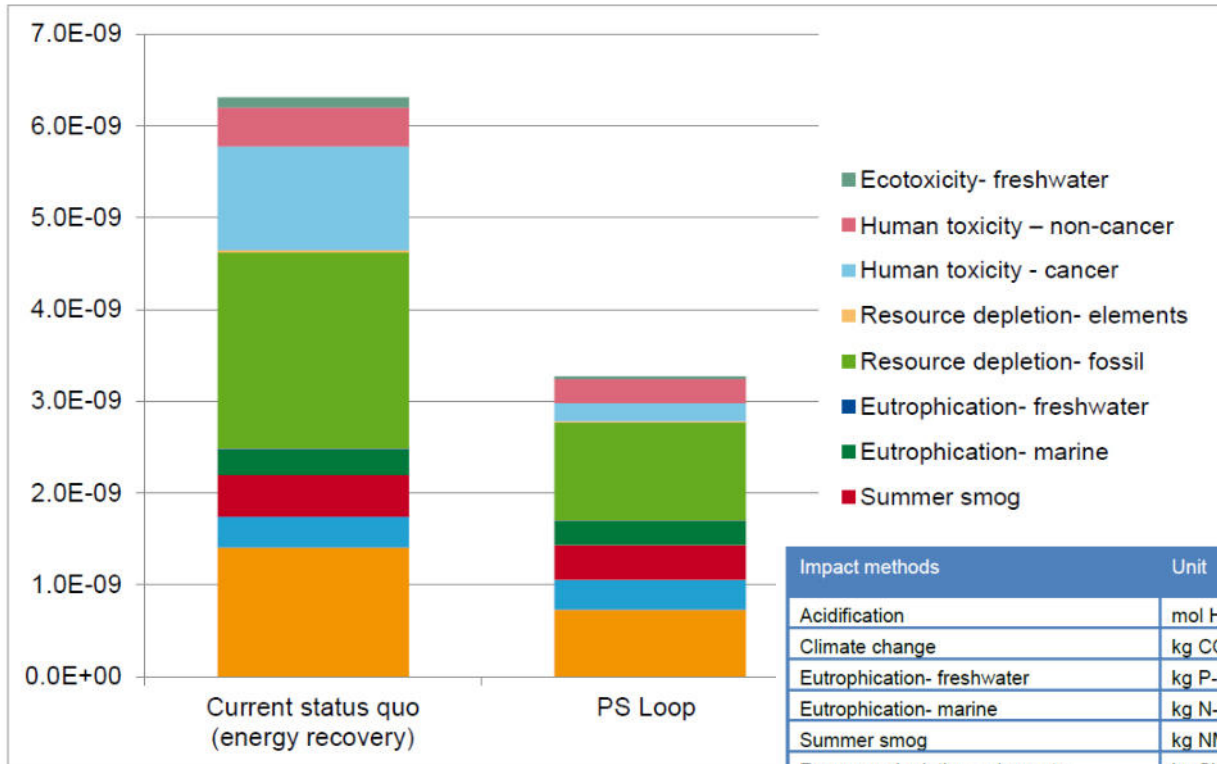
The study concludes that the PSLoop process shows a lower environmental impact in the categories climate change, eutrophication (freshwater), summer smog, resource depletion (fossil, elements), human toxicity (non-cancer, cancer) and freshwater ecotoxicity in comparison to Current Status Quo, incineration with energy recovery. Effects for acidification and eutrophication (marine) are comparable for both alternatives (differences < 15%). The environmental impacts of Current Status Quo, incineration with energy recovery, are mainly influenced by incineration of untreated ETICS waste. Furthermore, the used system expansion, especially for producing polystyrene, influences the overall results for this end of life technology.

The study was critically reviewed by independent experts. Overall, the critical review found the quality of the chosen methodology and its application in the analysis to be adequate for the purpose of the study and in conformance with the ISO 14040 and ISO 14044 standards. For the PSLoop process the study describes a future recycling scheme with large-scale application in place, which is currently still in the development phase. This results in some uncertainties with respect of waste streams and specifications as well as process data, in particular for the CreaSolv® Process. As stated in the study, the Technology Readiness Level (TRL) varies between TRL 3 and TRL 4, which mean technology and used data is validated in lab scale. In order to subsequently remove some of these inherent uncertainties reviewers recommended to perform a comprehensive update of the study when the pilot plant phase has been finished and more reliable data are available.

The technology

PSLoop using the CreaSolv® Process

Life Cycle Assessment: PSLoop versus Incineration



Normalised results for environmental impacts.

Impact methods	Unit	Normalization factor
Acidification	mol H ⁺ -eq.	2.36E+10
Climate change	kg CO ₂ -eq.	4.60E+12
Eutrophication- freshwater	kg P-eq.	7.41E+08
Eutrophication- marine	kg N-eq.	8.44E+09
Summer smog	kg NMVOC-eq.	1.58E+10
Resource depletion - elements	kg Sb-eq.	3.16E+07
Resource depletion - fossil	MJ	3.51E+13
Human toxicity - cancer	CTU _h	1.84E+04
Human toxicity – non-cancer	CTU _h	2.66E+05
Ecotoxicity - freshwater	CTU _e	4.36E+12

Environmental Benefits

Life Cycle Assessment

END OF LIFE TREATMENT OF EXPANDED POLYSTYRENE (EPS) FROM EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS (ETICS)

