

Expanded Polystyrene: Initial Successes in EPS Circular Economy Concept



Sample material from mechanical deconstruction of an external thermal insulation composite system (ETICS)

Vienna (OTS) – Expanded polystyrene, also known as Styrofoam or EPS, is 100% recyclable. However, currently, only about a quarter of construction materials and half of packaging materials made from EPS are recycled. In the research project "EPSolutely," twelve partners from across the value chain, led by Fraunhofer Austria, have achieved initial successes in creating a circular economy for EPS.

EPS is suitable not only as thermal insulation in house construction but also as lightweight, shock-absorbing, and thermally insulating packaging for a wide range of goods. According to the latest Conversio study, the EPS recycling rate in Austria is 26% for construction materials and 56% for packaging. However, recycled material is often only used as thermal insulation levelling fill. In terms of sustainability, a true circular economy would be desirable, where recycled EPS is converted into equivalent raw material and reintroduced into the cycle.

Economic and Ecological Aspects

The "EPSolutely" research project, accompanied by the Plastics Cluster and led by Fraunhofer Austria, is well on its way to developing and demonstrating economically and ecologically viable concepts for an EPS circular economy. In the first year of the project, the consortium, which includes companies from across the entire value chain, as well as interest groups and research institutions, has already achieved significant successes, bringing them closer to this goal.

Contaminated EPS after Demolition Work

The deconstruction of a facade poses a challenge to the circular economy from the outset. After demolition work, EPS is mixed with foreign materials such as plaster, adhesives, reinforcement meshes, and dowels, and in most cases, it also contains Hexabromocyclododecane (HBCD). This flame retardant was used in Austria until 2015 and is now banned. EPS containing HBCD is not considered hazardous waste, but it must be destroyed and cannot be reintroduced into the cycle. The CreaSolv® process, developed by the Fraunhofer Institute for Process Engineering and Packaging (IVV), enables the separation of HBCD in a solvent-based process, allowing polystyrene recyclates to be obtained from this material as well.

Promising Solutions

However, to conduct this process economically, the material must first be thoroughly cleaned of contaminants. *"The circular processing of EPS from demolition or deconstruction is considered extremely complex due to the contaminants. Together with our project partners, we have developed and experimentally tested various approaches to processing this material. So far, all results have been very promising,"* explains Sebastian Lumetzberger, who leads the project at Fraunhofer Austria.

Removal of Foreign Materials and HBCD

For the studies, the project partners analysed material contaminated to varying degrees from manually and mechanically conducted facade deconstructions. To separate the bond between EPS and the remaining components of the external thermal insulation composite system, the material was first shredded. The experiment showed that even severely contaminated material could be shredded, and the material separation between the EPS and the other components was successful. The next step was to remove foreign materials from the material mixture. A combined system of vibration and air technology was used for this – with great success.

Shredding and Sorting

"The shredding and sorting of the material worked excellently. Based on these results, we are very confident that we can find solutions together with the project partners to ensure that the processing of the material no longer hinders recycling," says Lumetzberger. After the studies are completed, the processed material will be sent to Fraunhofer IVV, where the CreaSolv® process will be used to remove the remaining contaminants and HBCD. The polystyrene recyclates obtained will be processed by the project partners into new EPS insulation boards.

Recycled EPS Packaging

The project partners were also successful with clean EPS packaging. In an experiment, they produced transport packaging for refrigerators using 100% recycled EPS (rEPS) from waste generated by the furniture industry. There was no noticeable loss of quality in terms of mechanical load capacity or appearance. To ensure that contaminated EPS packaging can also be processed in the future, the project will examine whether the CreaSolv® process can be used for recycling contaminated EPS packaging. A particular challenge is the large volume of EPS packaging. Just 60 kilograms can fill a small van. To transport the material efficiently and subject it to recycling, it needs to be compacted as early as possible in the process.

Pilot Project on EPS Offcuts from Construction Sites

The volume of EPS is also an issue when collecting offcuts generated when installing new EPS boards on construction sites. These can, if collected cleanly, be directly reused in EPS production as they contain the new safe flame retardant PolyFR and no longer HBCD. However, they must not be compressed for this purpose. Depending on the size of the building, varying numbers of bags with EPS offcuts are generated. *"We place particular emphasis on finding solutions for both small and large*

quantities. To this end, we have developed various concepts, such as direct collection from the construction site or collection in hubs," explains Lumetzberger.

Efficient Logistics

The project team has designed bags with QR codes for collection. These can be scanned to access a web application that initiates collection. This reduces the effort on the construction site, and the collection can be efficiently coordinated. Additionally, RFID tags are intended to enable tracking of the bags, creating transparency in material flows. As a logistician, Sebastian Lumetzberger is optimistic: *"We are developing possible concepts, evaluating them from an ecological perspective, and examining their economic viability, as the circular economy must also be profitable for companies. I am convinced that together with the project partners, we will be able to find the first efficient and practical solutions in the coming months."*

www.fraunhofer.at, www.styropor.at, www.kunststoff-cluster.at

- Project: EPSolutely - Development of a Circular Economy Concept in the Plastics Industry Using the Example of EPS
- Duration: January 2022 to June 2024
- Project Coordinator: Fraunhofer Austria

Project Partners:

Austrotherm GmbH, Flatz GmbH, HIRSCH Porozell GmbH, LIEBHERR-HAUSGERÄTE LIENZ GmbH, Lindner-Recyclingtech GmbH, LuSt Malereibetrieb & Vollwärmeschutz GmbH, O.Ö. Landes-Abfallverwertungsunternehmen GmbH, PORR Umwelttechnik GmbH, Saubermacher Dienstleistungs AG, Steinbacher Dämmstoff GmbH, UNPOR Kunststoff GmbH, XXXLutz KG

This project is funded under the FFG FTI Initiative Circular Economy through FFG funds. www.ffg.at