

ciRcular prOduction of flexiBle poyUrethane-baSed producTs

Abstract:

ROBUST, Turkish-Hungarian R&D cooperation, will address the sustainability challenges in the consumer goods manufacturing industry through scaling up the recirculation of resources. The project focuses on the chemical recycling of polyurethane foams (PUF) and the sustainable manufacturing of products containing PUF, specifically across the mattress production and plastics value chains. Chemical recovery processes of flexible PUFs through acidolysis and glycolysis will be examined within the project. Both components will be valorised for flexible foams, adhesives and coatings applications, for the first time offering a solution for the conversion of HSR into high-value products.



Countries involved



Application sectors

Consumer goods, Industrial components

Research and innovation domains

Advanced manufacturing processes, Sustainable manufacturing

Total cost in M€ (millions)

546 M€

Starting date

01/01/2024

Duration (in months)

36 months

Project leader

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Project participants

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RATIONALE OF THE PROJECT

“The ROBUST project addresses the urgent environmental challenge of polyurethane foam (PUF) waste accumulation, particularly in the bedding sector, where up to 30 million mattresses reach end-of-life annually in Europe. Existing waste management practices, notably landfilling (49%), fail to align with EU circular economy directives. To tackle this, ROBUST proposes an innovative approach centred on the chemical recycling of flexible PUFs via acidolysis and glycolysis, converting them into high-value components for new mattress production, adhesives, and coatings.

The project brings together Turkish and Hungarian R&D and industrial partners to establish a sustainable production model through resource recirculation. Key challenges include optimising depolymerisation reactions for industrial scalability, managing variability in waste foam quality, and ensuring that recycled polyols meet stringent mechanical and chemical performance standards. ROBUST also aims to valorise hard segment residues—an often neglected by-product—into rigid foams and polyurea coatings, thereby maximising waste utilisation and contributing to the EU’s Green Deal objectives on waste prevention and sustainable manufacturing.”

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

ROBUST delivers a significant technological advance beyond the state-of-the-art (SoA) in polyurethane foam (PUF) recycling by integrating acidolysis and glycolysis methods for the recovery of polyols and hard segment residues (HSRs). Unlike conventional approaches limited by low recyclability and high virgin polyol dependency, ROBUST targets the use of $\geq 30\%$ recycled polyols in flexible foam formulations while preserving key mechanical properties. The project also pioneers the valorisation of HSRs—typically discarded—by converting them into rigid foams, polyurethane adhesives, and polyurea coatings, contributing to near-total material circularity.

Key technological achievements include:

- Optimised depolymerisation processes (acidolysis and glycolysis) at pilot scale;
- Formulation of industrial-grade flexible and rigid PU foams from recycled content;
- Development of novel PU adhesives and nano-reinforced polyurea coatings;
- Integration of LCA and quality assurance tools to monitor carbon footprint and recyclability.

These innovations have enabled the conversion of $>95\%$ PUF waste into marketable products, reduced virgin resource dependency, and demonstrated technical feasibility for circular manufacturing in consumer goods.

MARKET POTENTIAL

The global polyurethane foam market is projected to reach USD 78.16 billion by 2029, driven by increasing demand in bedding, furniture, and automotive sectors. In Europe alone, over 50 million mattresses are produced annually, 90% of which contain PUF. ROBUST targets this high-volume market by offering recycled-content alternatives, aligned with EU sustainability goals.

YATAŞ, as a market leader with distribution in 48 countries, provides direct access to consumer goods markets, while EUROPUR membership supports wider industry dissemination. Partners TTK and BBS extend reach into polymer innovation, coatings, and adhesives sectors. With growing consumer demand for sustainable products, the consortium is positioned to commercialise recycled PUF-based mattresses, adhesives, and coatings rapidly, offering both environmental value and cost efficiency.

IMPACT POTENTIAL

ROBUST contributes to the EU Green Deal by reducing PUF waste and promoting circular economy practices. It enables the recovery of $\geq 95\%$ of waste materials and cuts greenhouse gas emissions by $\geq 50\%$ compared to landfilling. The project fosters sustainable manufacturing by replacing virgin polyols with recycled ones, enhancing resource efficiency. Its scalable solutions for mattresses, adhesives, and coatings strengthen Europe's innovation capacity and industrial competitiveness while aligning with REACH and ISO 14001 standards.