From waste PU foams to secondary raw materials

E. Koša[1], D. Pahovnik[1], E. Žagar[1*]

[1]*National Institute of Chemistry, Ljubljana, Slovenia*
[*]*ema.zagar@ki.si*

Polyurethane foams (PUFs) are versatile materials that are widely used as comfort and insulation materials. With the increasing production of PUFs, the amount of PUF waste is also increasing. Currently, these materials are usually disposed of in landfills at the end of their life. With the drive towards a circular economy, recycling is becoming increasingly important. For PUFs, mechanical recycling is not the most suitable method due to the loss of material properties and the associated downcycling. Recently, attention has turned to more suitable chemical recycling technologies based on the cleavage of urethane groups in the PUF structure.

Over the years, various chemical recycling processes based on the cleavage of the urethane bonds have been developed to produce recycled polyols as secondary raw materials. The recycled polyols are generally used for less demanding applications such as the synthesis of rigid PUFs or as a partial substitute for virgin polyols in the synthesis of flexible PUFs. Unfortunately, the degradation of the urethane bonds in the PU foam structure is not selective and, depending on the reaction conditions, the hard segments are also degraded, leading to the formation of unwanted amines. Only acidolysis of PU foams allows the formation of a small amount of amines during the process, as the carboxyl groups act as amine scavengers, but at the expense of functionalizing the polyol with carboxyl groups by esterification as a side reaction, which has a negative impact on the synthesis of new PUFs.[1]

Here we present a chemical recycling process for PUFs using a cheap and readily available reagent that produces recycled polyols that are good equivalents to the corresponding virgin polyols, while the formation of amines during the process is low.[2] Recycled polyols have been successfully used for the synthesis of new flexible PUFs with properties comparable to those of PUFs synthesized from virgin polyols.

Keywords: flexible polyurethane foams, recycling, secondary raw materials

Acknowledgments

The authors acknowledge the financial support from the Slovenian Research and Inovation Agency, ARIS (Research project No. J2-50054 and Research Core Funding No. P2-0145).

References

[1] Grdadolnik, M.; Drinčić, A.; Oreški, A.; Onder, O. C.; Utroša, P.; Pahovnik, D.; Žagar, E. Insight into Chemical Recycling of Flexible Polyurethane Foams by Acidolysis. *ACS Sustainable Chem. Eng.* **2022**, 10 (3), 1323–1332.

[2] Žagar, E.; Pahovnik, D.; Koša, E.; Grdadolnik, M.; Pavlica, D. J. Process for recovering raw materials from polyurethane waste. 2024, LU506968