Title:

ELV Directive Demands: Pioneering Recycling Solutions for Automotive Plastic Waste

Authors and Affiliations:

Lukas Killinger[1,2], Ronny Hanich-Spahn[1], Pranav Majgaonkar[1,3]

[1]Polymer Engineering, Fraunhofer Institute for Chemical Technology, Joseph-von-Fraunhofer-Straße 7, 76327 Pfinztal

[2]Institute for Organic Chemistry, Heidelberg University, Im Neuenheimer Feld 270, 69120 Heidelberg

[3]Institute of Process Systems Engineering, Hamburg University of Technology, Am Schwarzenberg-Campus 4 (C), 21073 Hamburg, Germany

Abstract:

Plastic is the second most-commonly used material in vehicles. Up to 39 different types of plastics account for 12%-15% of the weight of a vehicle[1,2]. By virtue of the increasing demand for high-performance yet light-weight options for mobility, the use of plastics in vehicles is expected to increase in the future[3]. This not only results in high amounts of plastic waste but also increases the dependence of the automotive industry on fossil feedstock. Therefore, the European Union proposes a recycling rate for plastics in vehicles in an update of the end-of-life vehicle directive. Up to 25% of the plastic in a newly manufactured car should come from recycling and biobased material[4]. This constitutes a challenge for all manufacturing companies and requires innovative recycling strategies for plastic waste from end-of-life vehicles.

Research at Fraunhofer ICT has been directed towards developing chemical recycling strategies for common poly-condensed fractions present in mixed waste streams. It lays the foundation for a systematic approach to identify potential solvents that not only result in selective depolymerization of the target polymer but also improve the sustainability of the process[5]. For instance, chemical recycling of polycarbonate (PC) which is widely used in car-bumpers and motor-headlights using methyl acetate as a solvent to yield dimethyl carbonate represents an eco-friendly and energy-efficient alternative for the production of this platform chemicals; by reducing the green-house gas emissions by 36%, as compared to its conventional production from fossil feedstock[6]. Further, chemical recycling of polyurethane (PUR) foams from car-seating and insulation panels allows us to recover polyols, which can substitute virgin polyols used in the production of such foams to an extent of 30%[7]. In addition, polyethylene terephthalate (PET) fibres used in car-seating can be recycled using a glycolysis process, which enables the recovery of the constituent monomer, that can be reprocessed to new PET fibres[8].

In this presentation at the Advanced Recycling Conference 2025, researchers at Fraunhofer ICT will present these developments to underline the pivotal role of chemical recycling for achieving the over-arching goal of circularity and sustainability in the automotive industry.

---

[1] A. Merkisz-Guranowska, IOP Conf. Ser.: Mater. Sci. Eng. 2018, 421, 32019.
[2] A. Patil, A. Patel, R. Purohit, Materials Today: Proceedings 2017, 4, 3807–3815.
[3] M. Kosacka-Olejnik, IFAC-PapersOnLine 2019, 52, 1733–1737.
[4] Kreislaufwirtschaft: Rat legt Standpunkt zum Altfahrzeug-Recycling fest - Consilium
[5] P. Majgaonkar, K. Kruber, V. Aryan, R. Hanich, D. Pico, M. Skiborowski in Computer Aided Chemical Engineering, Elsevier, 2022.
[6] Shreyash Gujar, Pranav Majgaonkar, Davide Pico, DE102023116198B3, 2023.
[7] C.-C. Höhne, R. Hanich-Spahn, P. Brantsch, Nioac de Salles, Ana Claudia, S. Ilinzeer, R. Emmerich, T. Reichert, Polyurethane Seating Structure for Aviation Applications - Environmental Improvements, Fraunhofer-Gesellschaft, 2023.
[8] L. Killinger, R. Hanich-Spahn, K. Flick., A.S.K. Hashmi, Polym. Degrad. Stab. 2025, 233, 111163