Biodegradable and bio-based aliphatic polyurethane foams

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Polyurethane (PUR) foams are, due to their high tunability and versatility, unambiguously the most globally produced thermosets. However, conventional / commercial PUR foams based on aromatic polyisocyanate have relatively low resistance to abiotic photo-degradation. As a result, these materials are unsuitable for outdoor applications, where their mechanical disintegration occurs relatively easily with the formation of microplastics, or the production of toxic degradation products. For this reason, in recent years, there have been works that aim to prepare more environmentally friendly PUR foams that would be easier to recycle or willing to biodegrade without the formation of toxic decomposition products.
In past, we have developed fully aliphatic PUR foams that show biodegradable behaviour in various environments [1,2]. Such kind of foams may find a number of applications, e.g. as matrices for biofiltration [3] or as porous carriers in wastewater treatment plants [4].
This contribution shows the influence of chemical composition, supramolecular arrangement and macroscopic properties (cell morphology and mechanical properties) on the degradation behaviour of fully aliphatic PUR foams. It is shown that to ensure sufficiently fast degradability and recycling via solvolysis of the PUR foams, it is necessary, in addition to choosing the appropriate structure of the starting monomers, to control the development of the supramolecular arrangement of the PUR network. The replacement of petrochemical raw materials with bio-based feedstocks and their influence on the final properties of PUR foams, their (bio)degradation behaviour and solvolysis are also discussed.

Keywords: polyurethane foam, biobased feedstock, biodegradation

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