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Synthesis of fully biobased and reprocessable polyurethane foams

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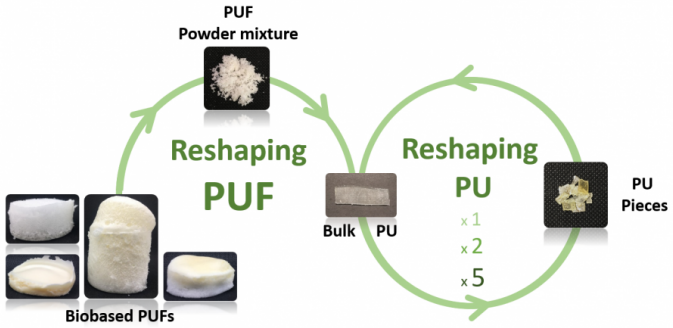
PURPOSE OF THE ABSTRACT

The development of renewable materials is a current major concern to reduce the impact of human activities to environment and climate and ensure sustainable consumption and productions. In 2019, 368 million tons of plastics were produced in the world and only less than 1 % were biobased. However, the production of biobased monomers was widely developed to achieve sustainable polymers such as polyamides, polyurethanes, epoxy-resins and polyesters. Polyurethanes (PUs), obtained through the reaction of polyisocyanates and polyols, are the 6th most produced polymer in the world and their demand is constantly growing due to their excellent properties and their high versatility. Therefore, they are present in a wide range of applications like coatings, elastomers and sealants but two third of their production is devoted to foams. [1]

Many biobased polyols are nowadays available in the market, obtained from vegetables oils, carbohydrates, proteins and lignin. On the other hand, biobased polyisocyanates are very few, therefore, partially biobased PUs are produced with biobased polyols and petrobased polyisocyanates. Nevertheless, with the commercialization of biobased polyisocyanates, fully biobased PUs are under development. [2] In the same way, biobased polyurethane foams (PUFs) described in the literature are only partially biobased, often using petrobased polymeric 4,4'-methylene bis(phenyl isocyanate) (pMDI). [3]

In this study, four fully biobased PUFs were synthesized with a biobased carbon content up to 93 % and their thermomechanical and physical properties were studied. The development of new biobased monomers and polymer materials is an essential step to increase the sustainability of plastic industries. However, not only the first synthesis step needs to be improved, but the whole life cycle of polymers and especially their end-life. Indeed, the plastic demand is constantly growing and they are mainly used for single use packaging. They strongly participate to increase the amount of waste and their dispersion in the environment. Therefore, the recyclability of polymers is a major challenge. To this aim, transcarbamoylation was used to recycle the PUFs by compression molding in the pursuit of a greener consumption model, the PUFs were reshaped over five cycles. Their vitrimer properties were fully characterized.

FIGURES



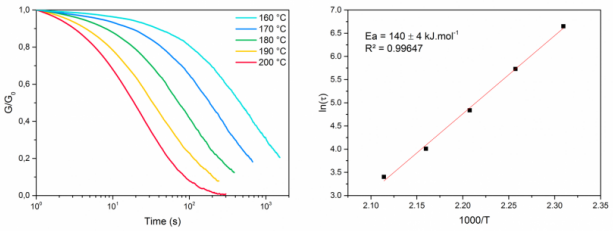


FIGURE 1
Biobased polyurethane foams reshaping strategy

FIGURE 2
Sress relaxation measurements of PU after reprocessing

KEYWORDS
Biobased | Polyurethanes | Foams | Vitrimer

BIBLIOGRAPHY

[1] Eling, B., Macromol. Chem. Phys. 2020, 221 (14), 1-11
[2] Morales-Cerrada, R. Polymers, 2021, 13 (8) 1255
[3] Peyrton, J. Mater. Sci. Eng. Reports, 2021, 145, 100608