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Deep Eutectic Solvents as Promoters of Supercritical Fluid Foaming of Natural-Based Polymers

Marta MARTINS[a], Ivo AROSO[a], Rita CRAVEIRO[b], Alexandre PAIVA[b], Rui REIS[a], Ana Rita DUARTE[a]
[a]*Universidade do Minho, Caldas das Taipas, Guimarães, PORTUGAL;* [b]*Universidade Nova de Lisboa, Caparica, PORTUGAL*

✉aduarte@dep.uminho.pt

Supercritical fluid foaming of semi-crystalline natural-based polymers has been studied using ionic liquids as plasticizing agents, promoting hereafter foaming of the structures. Deep eutectic solvents (DES) are considered today a new generation ionic liquids. DES can be constituted by two natural primary metabolites, namely, aminoacids, organic acids, sugars or choline derivatives and are in this case called natural deep eutectic solvents (NADES). Furthermore, they can even be constituted by an active agent, such as ibuprofen, for example. In this work, we evaluate the possibility of dopping a natural-based polymer, particular a blend of starch and poly-e-carolactone (70:30) with different NADES. The polymers dopped with 10 wt% of each NADES were processed by compression moulding to obtain a homogeneous structure. The compressed mould specimens were tested in order to evaluate their mechanical properties, in tensile mode, and the results suggest that the presence of NADES was able to lower the Young modulus of the samples and its elongation at break, providing cues that NADES may have a plasticizing effect on the polymer matrix. The samples were foamed under supercritical carbon dioxide at 200 bar, 40ºC for 2 hours and the morphological characterization of the samples was assessed by scanning electron microscopy and micro-computed tomography. The porosity of the samples is highly depended on the NADES used. An increase in porosity for up to 52%, in the case of polymer dopped with choline chloride-sucrose (1:1). The results demonstrate the high potential of NADES as enhancers of the supercritical fluid foaming. When compared to conventional imidazolium ionic liquids they present further advantages, namely the biocompatibility and toxicological concerns that have hampered the use of ionic liquids as green solvents, particularly in the biomedical field.