

Effect of co-solvents on the microcellular foaming behavior of TPU using supercritical CO₂.

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Polyurethanes are usually foamed with traditional blowing agents such as azodicarbonamide and hydrofluorocarbon [1]. However, these blowing agents can leave some chemical residue in the polymer, and release toxic gas [2]. For this reason, alternative methods are being studied, like supercritical fluid foaming. Carbon dioxide (CO₂) is the most widely used supercritical fluid, due to the mild conditions needed to reach its supercritical state compared to other substances and it is environmentally friendly properties, as it is inert and non-toxic, and offers the versatility needed to treat different raw materials.

Thermoplastic polyurethane (TPU) combines the excellent properties of the soft and hard segments in the macromolecular chain, which provides the material with many superior properties, including high elasticity and resilience [3]. In addition, TPU foams show a promising future in many industrial fields such as athletic footwear and automotive accessory. The present work focuses on the influence of temperature, pressure, contact time and the use of different co-solvents in the foaming of TPU using supercritical CO₂.

To determine the influence of pressure, temperature, contact time, and the presence of co-solvents in the foaming process of TPU with supercritical CO₂. The following foaming conditions were studied:

- Temperature: 130 °C- 160 °C
- Pressure: 130 bar, 160 bar, and 200 bar
- Contact time: 3 h, 6 h, and 24 h
- Co-Solvent: THF, DMSO, and Acetone

TPU was characterized using DSC analysis to determine the melting point and the hard segment crystallization of the polymer. After foaming experiments, the density of the foams was measured using a density balance, SEM analysis was also done. Using the information provided by the density measurement and SEM, cell density, average cell size, and expansion ratio were calculated for the different conditions of pressure, temperature, and contact time with and without co-solvent.

REFERENCES

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GRAPHICAL ABSTRACT

