

Effects of polyol composition on physico-morphological and mechanical properties of polyurethane foams

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In the last years, increasing interest has been paid to polyurethane (PU) foams with open porosity to be used as scaffold in numerous tissue engineering applications. In fact, they possess good cyto- and biocompatibility, and they can be synthesized with tunable chemico-physical and mechanical properties by varying the base reagents used for their synthesis (polyol, isocyanate, and expanding agent) and the stoichiometric ratio between them. The aim of this work was to design and develop novel PU foams with high open porosity and tunable physical and mechanical properties by varying the polyol composition and the stoichiometric ratio between the base reagents. PU foams were synthesized by a one step gas foaming method (stoichiometric and not stoichiometric foams), by reacting a polyol mixture ad hoc set up with MDI prepolymer, using Fe-AA as catalyst, and water as expanding agent. Different polyol mixtures were prepared by varying the ratio between the main polyol components, e.g. a polyether-polyol (component A), a polyether-polyol containing styrene (component B), and an amine-based tetrafunctional polyether-polyol (component C). The PU foams were characterized by SEM, micro-CT, ATR-FTIR analysis, and evaluation of density, water uptake, and mechanical properties by uniaxial compressive tests in dry and wet conditions.

Polyol composition do not affect PU foam open porosity, while the pore size and water uptake increase with the increase of components B and C. All the foams show higher compressive properties in dry than in wet state, due to the plasticizing effect of water. PU foams synthesized with an excess of diisocyanate are significantly stiffer than the stoichiometric ones. In addition the compressive properties of the PU foams are mostly affected by the amine-based tetrafunctional component, that causes a higher level of cross-linking, stiffness and strenght. Preliminary tests show no cytotoxic effects for all the tested PU foams.