INVESTIGATION OF SHRINKAGE-OPTIMIZED RESIN VIA TMOR

Maurice Gilberg, Jan-Kristian Krüger, and Bernd Wetzel

Leibniz-Institut für Verbundwerkstoffe GmbH, 67663 Kaiserslautern, Germany

UV-curing plastics are particularly suitable for repairing defects due to their short curing time. They are already being used in the construction sector, the automotive industry and in medicine. A central problem of radically polymerizing systems is the polymerization-induced volume shrinkage during curing. As a result, precisely rehabilitated defects may no longer be satisfactorily repaired after the resin has cured. One variant for reducing polymerization-induced volume shrinkage is the use of prepolymers. Here, the prepolymer serves mainly as a volume constant unit that can be covalently incorporated into the network. Classically used prepolymers described in the literature are often linear in structure [1]. These lead to a low crosslink density during polymerization, which can have a negative effect on the mechanical properties of the material. In order to be able to use such shrinkage-reduced systems for mechanically demanding applications, polymer diphenylmethane diisocyanate (PMDI) is to be used as a primary prepolymer building block with the ability to form highly crosslinked plastics.

The current research work systematically investigated the influence of PMDI on the polymerization-induced volume shrinkage in an acrylic resin. The experimental results showed that volume shrinkage could be reduced by prepolymerizing the acrylic monomer with PMDI. Depending on the selected PMDI content, volume shrinkage could be reduced by up to 30% during curing. The Temperature Modulated Optical Refractometry (TMOR) was employed to determine and verify volume shrinkage and it allowed in situ monitoring of volume changes during the polymerization process very accurately [2].

[1] M. Atai, M. Ahmadi, S. Babanzadeh and D.C. Watts, Dent. Mater., 23, 1030 (2007).

[2] U. Müller, M. Philipp, M. Thomassey, R. Sanctuary and J.K. Krüger, Thermochim. Acta., 555, 17 (2013).