

Rule-Of-Mixtures: Predicting the Bending Modulus of Unidirectional Fiber Reinforced Dental Composites

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Abstract : Rule of mixtures is the simple analytical model is used to predict various properties of composites before design. The aim of this study was to demonstrate the benefits and limitations of the Rule-of-Mixtures (ROM) for predicting bending modulus of a continuous and unidirectional fiber reinforced composites using in dental applications. The Composites were fabricated from light curing resin (with and without silica nanoparticles) and modified and non-modified fibers. Composite samples were divided into eight groups with ten specimens for each group. The bending modulus (flexural modulus) of samples was determined from the slope of the initial linear region of stress-strain curve on 2mm×2mm×25mm specimens with different designs: fibers corona treatment time (0s, 5s, 7s), fibers silane treatment (0%wt, 2%wt), fibers volume fraction (41%, 33%, 25%) and nanoparticles incorporation in resin (0%wt, 10%wt, 15%wt). To study the fiber and matrix interface after fracture, single edge notch beam (SENB) method and scanning electron microscope (SEM) were used. SEM also was used to show the nanoparticles dispersion in resin. Experimental results of bending modulus for composites made of both physical (corona) and chemical (silane) treated fibers were in reasonable agreement with linear ROM estimates, but untreated fibers or non-optimized treated fibers and poor nanoparticles dispersion did not correlate as well with ROM results. This study shows that the ROM is useful to predict the mechanical behavior of unidirectional dental composites but fiber-resin interface and quality of nanoparticles dispersion play important role in ROM accurate predictions.

Keywords : bending modulus, fiber reinforced composite, fiber treatment, rule-of-mixtures

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