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Mechanical Properties of Polyurethane Scaffolds Reinforced with Green Nanofibers for Applications in Soft Tissue Regeneration

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Abstract : A new class of polyurethane (PU) reinforced with green bacterial cellulose nanofibers (BC) were prepared using a solvent casting method, with the goal of fabricating green nanocomposites. Four series classes of BC (1, 2.5, 5, and 10 wt%) were reinforced into PU matrices via BC surface modification and subsequently BC-grafted into PU throughout silane coupling agent to improve BC dispersion and its interfacial interaction. The experiment results from the tensile tester were evaluated according to the response surface method (RSM) for optimizing the impacts of variable parameters, pore size, porosity, and BC contents on the mechanical properties. The compressive strength for PU-5 BC wt% was about 9.8 MPa, and decrease when being generated prosperity to recorded at 4.9 MPa. Nielson model was applied to investigate the BC stress concentration on the PU matrices. Likewise, krenche and Hapli-Tasi model were employed to evaluate the BC nanofiber reinforcement potential and BC orientation into PU matrices. The analysis of variance (ANOVA) demonstrated that only BC loading has a significant effect in increases tensile strength, young's modulus, and a flexural modulus of the PU-BC nanocomposites. The optimal factors of the variables experiment confirmed to be 5 wt% for BC, 230 for pore size, and 80 % for porosity. Scanning electron microscopy (SEM) micrographs showed that the uniform distribution of nanofibers in the PU matrices with the addition of BC 5 wt %. Hydrolytic degradation revealed that the weight loss in PU-BC scaffold is higher than PU-BC wt %.

Keywords : polyurethane scaffold, mechanical properties, tissue engineering, polyurethane
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