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Composition optimization of PLA/PPC/HNT nanocomposites for mandibular fixation plate using single-factor experimental design

[Journal of the Mechanical Behavior of Biomedical Materials](#) • Article • 2022 •

DOI: 10.1016/j.jmbbm.2022.105423

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Abstract

The need to overcome the secondary surgery to remove implanted metal fixation plate leads to the idea of replacing the material with degradable bionanocomposite. In this research, polylactic acid/polypropylene (PLA/PPC) blends incorporated with halloysite nanotubes (HNT) (0–6 wt %) were considered as the candidate material for mandibular fixation plate. A single-factor design using Design Expert software was used to determine 20 different compositions of PLA/PPC/HNT

nanocomposites and their mechanical properties were then measured. The optimization of the PLA/PPC/HNT nanocomposite composition was performed based on the nanocomposite's response to Young's modulus, tensile strength, and elongation at break. Further analysis suggested an optimum composition of 92.5/7.5 PLA/PPC with 6 wt % of HNT. The statistical results predicted that there was a 71.7% possibility that the proposed nanocomposite would have the following mechanical properties: Young's modulus of 2.18 GPa, a tensile strength of 64.16 MPa, and an elongation at break of 106.53%. © 2022 Elsevier Ltd

Author keywords

Design of experiment; DOE; Fixation plate; Nanocomposites; Optimization; PLA/PPC/HNT; Polylactic acid/polypropylene carbonate/halloysite nanotube

Indexed keywords

MeSH

Cellulose; Clay; Nanocomposites; Polyesters; Polypropylenes; Research Design

Engineering controlled terms

Design of experiments; Elastic moduli; Kaolinite; Nanotubes; Plate metal; Polyesters; Tensile strength

EMTREE drug terms

cellulose; nanocomposite; polyester; polypropylene

Engineering uncontrolled terms

DOE; Elongation-at-break; Fixation plate; Halloysite nanotubes; Optimisations; PLA/PPC/halloysite nanotube; Polylactic acid/polypropylene carbonate/halloysite nanotube; Polypropylene carbonate; Young modulus

EMTREE medical terms

clay; methodology

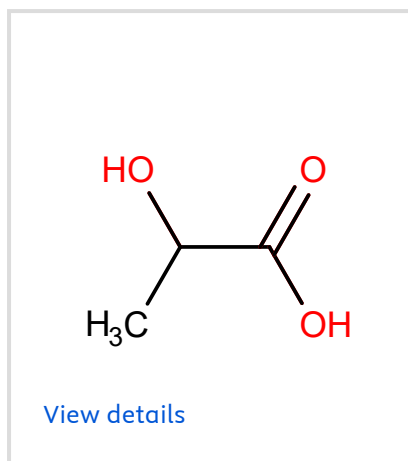
Engineering main heading

Nanocomposites

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polypropylene	25085-53-4, 9003-07-0
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Cellulose

Clay

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