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RESEARCH ARTICLE

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Influence of polymer solution composition on the microstructure and thermal and mechanical characteristics of polycaprolactone films

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Abstract

This study investigates the effects of addition of oils and alkanes to the polymer solution on the properties of polycaprolactone (PCL) films. The films were prepared by casting films onto a mold and evaporation in air. Films made without oils showed a dense microstructure. Most of the oils generated porous films, except for cyclohexane and castor oil. The neat PCL and cyclohexane films were stronger than other films, with a tensile strength of about ∼11.5 MPa, followed by terpenes (∼6.5 MPa) and the weakest films were obtained with hexadecane (∼3.5 MPa). The elastic modulus was highest with limonene (∼350 MPa), followed by cyclohexane (∼150 MPa), and the lowest modulus (∼65 MPa) was obtained with castor oil and hexadecane. All films showed high elongation at break (>400%). The degree of crystallinity was the highest with terpenes, whereas the lowest crystallinity was obtained with hexadecane. No significant effect of the oils on the thermal transition temperatures of the films could be observed. In summary, the microstructure and mechanical properties of the PCL films could be effectively fine-tuned for various applications through the addition of oils and alkanes to the polymer solution.

Highlights

- Oils and alkanes were added to polycaprolactone (PCL) casting solution.
- PCL films were prepared by casting films onto a mold and evaporation in air.
- Oils affected the microstructure and mechanical properties of the films.
- Addition of oils provides a flexible tool to tailor the film properties.
- PCL films with varying properties could be fabricated for different fields.

KEYWORDS

film casting, mechanical properties, morphology, oil, polycaprolactone

1 | INTRODUCTION

In recent years, biodegradable polymers have received much attention as potential alternatives to nonbiodegradable polymers and plastics as they can be easily degraded in the environment by microorganisms leading to less accumulation of polymer waste and consequently less pollution.[1,2] Biodegradable polymers can be either natural such as starch, cellulose, poly(butylene adipate-co-terephthalate), or synthetic like polylactide

