

# THE INFLUENCE OF COCAMIDOPROPYL BETAINE ON THE MECHANICAL AND THERMAL PROPERTIES OF POLYMER FILMS

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## Introduction

Polymer blending is one of the effective methods for providing new desirable polymeric materials for a variety of applications [1]. Several studies have been reported to blend natural polymers such as chitosan with synthetic ones for example poly(vinyl alcohol) (PVA) [2-4]. Chitosan and PVA create intermolecular hydrogen linkages among their polymer chains [5].

PVA is a polyhydroxy water-soluble polymer, non-toxic, biocompatible polymer with film-forming capacity and high tensile strength and flexibility [6,7]. PVA was used in many applications such as membrane preparations, food packaging, drug delivery systems, etc. [8,9].

Chitosan (CTS) is a natural polysaccharide, a derivative of chitin which is obtained from the exoskeleton of invertebrates [10]. Based on the characteristics of CTS, including antimicrobial activity, biodegradability, and UV-protective ability, it can be used for the preparation of films for various purposes [11].

Surfactants are widely applied to organic chemicals as they are one of the main ingredients in personal hygiene products and detergents [12]. Cocamidopropyl betaine (CAPB), belonging to the amidopropyl betaine group, is an amphoteric surfactant which has two ionic centers of different charge in one molecule (FIG. 1). CAPB shows a cleaning effect and acts as a foaming agent [13].

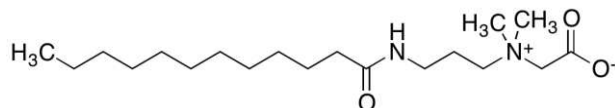


FIG. 1. Structure of cocamidopropyl betaine.

The aim of this study was to develop materials based on biodegradable polymers (PVA and chitosan) with the addition of the surfactant (cocamidopropyl betaine) to provide the film washing properties.

## Materials and Methods

Chitosan (CTS) and poly(vinyl alcohol) (PVA) were purchased from Sigma-Aldrich (Poznan, Poland). Cocamidopropyl Betaine (CAPB) was acquired from CHEMCO (Sobowidz, Poland). The molecular weight of PVA was 31,000-50,000 g/mol and the hydrolysis degree was about 98-99%. The deacetylation degree of chitosan was  $\geq 75\%$  and the average molecular weight was equal to 444,000 g/mol.

The films were fabricated from chitosan, poly(vinyl alcohol), and surfactant (cocamidopropyl betaine) using a casting solutions technique. Chitosan solution (2% w/w) and PVA solution (2% w/w) were mixed. The addition of the surfactant was 2%. The PVA/CTS films were prepared at various weight ratios to evaluate the optimum composition. The samples have been dried at room temperature for 7 days.

The properties of the polymer matrices were determined by mechanical tests and thermogravimetric analysis. The mechanical tests were conducted at room temperature using a mechanical testing machine equipped with tensile grips. Young's modulus and elongation at break were calculated. Thermal stability was performed by the thermogravimetric instruments in nitrogen with a heating rate of  $10^\circ\text{C}/\text{min}$  up to  $600^\circ\text{C}$ .

## Results and Discussion

The obtained results showed that the PVA/CTS films exhibited much higher values of Young's modulus compared to the matrices with the surfactant. The neat polymer blends were very stiff, while the PVA/CTS+CAPB films were more flexible. Moreover, the values of elastic moduli were also dependent on the composition of the prepared materials. The higher amount of chitosan increased the stiffness of the obtained matrices. It was noted that the PVA/CTS films had slightly lower elongation at break values than the films with the addition of cocamidopropyl betaine. It indicates that the prepared materials were brittle. The weight ratios of the polymers in the samples had an impact on the elongation at break values. The lower amount of PVA in the blends increased the fragility of the matrices. Thermal behavior of the studied blends depended on their composition. Higher content of PVA in the blends resulted in higher temperature at maximal rate decomposition of the samples. For the blends with 50 and 75% of PVA and the surfactant, the temperature at maximal rate process enhanced but for the blend with 25% of PVA and the surfactant, the temperature slightly decreased. Moreover, the presence of CAPB made the weight loss in the first stage more efficient.

## Conclusions

The prepared matrices based on biodegradable polymers with the addition of surfactant can be the starting point of producing novel materials to replace currently used wet wipes made of non-degradable polymers.

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