

Review of a Doctoral Thesis

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Title: Manufacturing of Blends based on Biopolyesters and Polylactides: Process-induced Structure and Properties
Supervisor: Prof. Ing. Berenika Hausnerová, Ph.D.

The dissertation is prepared as an independent work; it contains the results of experimental work during the doctoral studies.

In her dissertation, the PhD student studied the effect of extrusion blowing of selected polymer blends on their thermo-mechanical and visco-elastic properties and their morphology. The research was conducted on films prepared from PBAT/PLA (polybutylene adipate terephthalate/polylactic acid) blends.

The topic of the work is of high interest, because these composite films may find applications in the packaging industry. However, a limiting factor is their limited miscibility. Therefore, the research focused mainly on testing different types of commercially produced crosslinking agents (suitable for packaging applications in food and agriculture), which were added to the blends of the above-mentioned polymers at 1 wt.%.

The chapter dealing with the **current state of the art** corresponds very well with the thesis topic. In addition to introducing the properties of both polymers and their blends, the chapter focuses on the mechanical, rheological, thermal, and morphological properties of PBAT/PLA blends.

The objectives of the thesis are clearly defined, reflecting the insufficient knowledge of the use of multifunctional crosslinkers modifying selected polymer chains with respect to the polymer blend's processing properties and the finished products' utility properties.

The PhD student chose an appropriate **methodological solution** to the studied problem. The mixing of the mixtures was carried out on a 2-screw extruder and the preparation of the films on a laboratory blowing machine ($\varnothing=25$ mm, $L/D=30$, $t=165$ °C). The prepared films were characterized by a series of ISO and DIN tests: tensile strength, Young's modulus, tear strength (according to Elmendorf), seal strength. In addition, dynamic mechanical analysis and measurements on rotational rheometer were performed on the films, infrared spectroscopy with Fourier transformation was used to study changes after chemical reactions; and DSC was used to study thermal transitions in the materials. The molecular weight (M_n and M_w) was determined by GPC. Thermal aging (50 °C, 1-2 months) and study of mass changes after composting were also performed on the prepared films. **The results and discussion** of the work are clearly presented on pages 40 to 82 of the dissertation.

The dissertation meets the standards set for dissertations and contains all the recommended parts. The language is of a very good standard.

For the praxis, the dissertation provides new insights into the influence of commercially available crosslinking agents on the optimal processing conditions of PBAT and PLA blends, as well as the properties and structure of the final products. The results of biodegradation tests in compost are also significant.

The PhD student has **published** three original scientific papers as first author in 1st or 2nd quartile journals (*Polymers, International Journal of Molecular Sciences*), abstracted in the Web of Science database. She is currently the first author and co-author of 2 articles under review in journals classified as Q1 or Q2. The publication record shows that the experimental results obtained in this work have been successfully published.

The objectives of the dissertation were met.

To conclude, **I recommend** Juliana Vanessa Cardoso Azevedo's Doctoral Thesis for the final defense and, after a successful defense, to award her the Ph.D. degree.

Questions for the discussion:

1. What can explain the decrease and the increase in tensile strength and elongation at the break of the unmodified mixture specimens after the 1st and 2nd months concerning the initial condition (chapter 4.1.1 of the dissertation)?
2. From the weight loss results of the film samples, a major difference between films with added V1 and V2 CECL versus V3 and V4 CECL is evident (Chapter 4.4.1 of the thesis). Please provide a more detailed justification for this fact.
3. Why was 1 wt. % addition of tested V1-V4 CECL chosen?
4. Based on the observed properties of the prepared films and the results of the biodegradation tests, propose suitable applications of PBAT/PLA films modified with V1-V4 CECL for food (or other) purposes.

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