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Poster presentations

P1. K. Polaczek, M. Auguścik, M. Kurańska, A. Prociak, J. Ryszkowska: ***Open cell rigid polyurethane foams based on bio-polyols***

P2. M. Auguścik, J. Ryszkowska, L. Szczepkowski: ***Biocomposites of viscoelastic foams with mint***

P3. M. Barczewski, K. Biedrzycka, J. Aniśko, A. Kloziński, D. Matykiewicz, J. Andrzejewski, O. Mysiukiewicz, M. Szostak: ***The effect of UV light on mechanical properties and structure of polyurea spray coated composites filled with different inorganic fillers***

P4. K. Bialik-Wąs, K. Żyła, K. Pluta, D. Malina, K. Pielichowski: ***Determination of the encapsulation efficiency of model drug into PHAs nanocarriers***

P5. M. Borowicz, J. Paciorek-Sadowska, B. Czupryński, J. Liszkowska: ***Synthesis and application of new bio-polyol based on Oenothera biennis oil. Part 1. Synthesis of bio-polyol***

P6. J. Paciorek-Sadowska, M. Borowicz, B. Czupryński, J. Liszkowska: ***Synthesis and application of new bio-polyol based on Oenothera biennis oil. Part 2. Synthesis of rigid polyurethane-polyisocyanurate foams based on new bio-polyol***

P7. S. Bujok, H. Beneš, J. Kredatusová, M. Konefał, E. Pavlova, P. Ecorchard: ***Functionalization of layered double hydroxide for in-situ ring opening polymerization***

P8. K. González, L. Iturriaga, T. Calvo-Correas, A. González, A. Eceiza, N. Gabilondo: ***Strategies for improving the behaviour of extruded starch based films***

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P10. M. Celiński, K. Sałasińska: ***Flammability of polyols***

P11. A. Santamaria-Echart, I. Fernandes, M.F. Barreiro, T. Calvo-Correas, M.A. Corcuera, A. Eceiza: ***Water-borne polyurethane-ureas added with plant extracts with bacteriostatic characteristics***

P12. J. Vadillo, I. Larraza, A. Arbelaiz, M. Ángeles Corcuera, C. Save M., Derail, A.Eceiza: ***Effect of PCL/PEG ratio on the properties of waterborne poly-urethane-urea dispersions***

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Water-borne polyurethane-ureas added with plant extracts with bacteriostatic characteristics

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Introduction

The environmental awareness has promoted the development of new materials towards eco-friendly systems based on both, green synthesis processes and raw-materials of renewable origin. In this way, focusing the synthesis methods, the use of waterborne polyurethane-urea dispersions has gained attention due to their versatility leading to a wide variety of applications [1], broadening the range of applications. In addition, it is worth noting that the dispersibility in water offers the possibility of incorporating water compatible additives, such as plant extracts obtained by aqueous-based extraction procedures.

Therefore, in this work bioactive plant extracts from *Melissa officinalis L.* [2] were incorporated into waterborne polyurethane-urea dispersions (WBPUU), varying their content and using three different incorporation routes. These dispersions were characterized and employed in the preparation of films which were analyzed from the viewpoint of physicochemical, thermal, thermomechanical and mechanical properties as well as their morphology, among others. Finally, the antibacterial properties of the films were analyzed after 1 and 4 days of incubation, where it was observed that the content and incorporation route of the extracts has influenced the behavior of the films against common pathogens (*Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*).

Experimental

WBPUU was synthesized following a two-step polymerization process in heterogeneous medium using poly(ε-caprolactone) diol (PCL) (Mw = 2000 g mol^{-1}), isophorone diisocyanate (IPDI), 2,2-bis(hydroxymethyl) propionic acid (DMPA), and ethylendiamine (EDA) as chain extender. Bioactive extracts were obtained from *Melissa officinalis* plant by infusion method and incorporated into the WBPUU at 1, 3 and 5 wt% by 3 different routes: post (mixing with the already synthesized WBPUU dispersion dissolved in water), *in-situ* (adding during the phase inversion dissolved in the water) and pre (adding prior to the phase inversion dissolved in a small amount of water). The designed routes are shown in **Fig. 1** and resulting films were prepared by casting.

Results and discussion

Dispersions viscosity and particle size were analyzed. It was observed that the increase of extract content led to an increase in the dispersion viscosity. However, the particle size distribution broadened to smaller sizes, which could be attributed to the surfactant effect of extract components.

The antibacterial effect of WBPUU-extract films, shown in Fig. 1, against Gram positive bacteria *Staphylococcus aureus* ATCC 19213 and Gram negative *Escherichia coli* ATCC 10536 was analyzed after 4 days of incubation at 37 ºC. The base WBPUU film did not presented antibacterial effect. However, the incorporation of bioactive extracts promoted the bacteriostatic effect of the films against both bacteria, except in the case where the pre-method (3 wt%) was used, and for *E. coli* bacteria. This fact could be related with the intercalation mechanism of the extract and the polyurethane-urea nanoparticles, considering also that in general, Gram– bacteria are more resistant comparing with Gram+ bacteria [4].

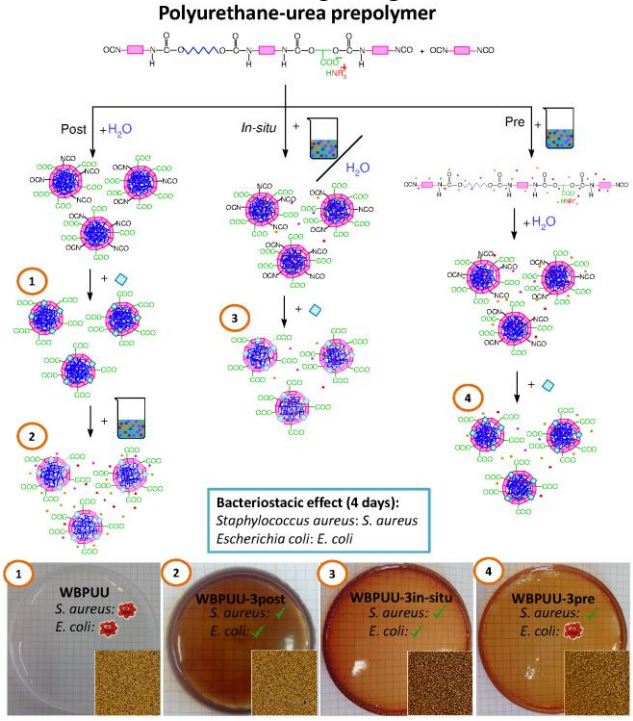

Fig. 1. *Bioactive WBPUU-extract systems preparation routes and AFM phase images of spin coated films (3x3 μm²).*

Conclusions

Different strategies were designed for the incorporation of aqueous bioactive extracts into WBPUU resulting in bacteriostatic environmentally-friendly materials [4]. The incorporation of plant extracts results in films with antibacterial properties, thus opening their applicability field.

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