Final Report (2013)

66p21 - Development of effective technology for production of biodegradable polymer nanocomposite films with advanced properties

Ass.Prof. Stephan Laske,

Ing. Alena Kalendová, Ph.D., doc. Mgr. Marek Koutný Ph.D.

The research project was focused on development of effective technology for production of biodegradable polymer nanocomposites. The project was planned for 2 years (project 63p24 in 2012, project 66p21 in 2013). In accordance with the proposed second experimental period (from 1. 2. 2013 - 31. 12. 2013) following research steps were completed:

1. Preparation of PLA-nanocomposites – II. Optimization of the compounding process applying different screw geometry, screw speed, screw fill factor and temperature profile.
2. Preparation of PLA-nanocomposite films by sheets film extrusion
3. Characterization of PLA-nanocomposite properties (Biodegradability, Rheology, Tensile testing, Thermal properties, Permeability, Structure e.g. X-ray diffraction)
4. Publication of results, organization of lectures

The resources of the project supported following visits of PhD, Master students and academic staff from Tomas Bata University in Zlin (TBU-FT) at Montanuniversitaet Leoben (MUL-KV):

2. 6. - 8. 6. 2013 Petr Stloukal – academic staff, started with optimization of the compounding process for selected nanocomposites samples of biodegradable polymer poly(lactic acid), PLA.

27. 11 – 6.12. Silvie Pekařová – Ph. D. student, measured the rheological properties of prepared PLA samples. At the same time, she attended the special lectures for Ph.D. students and bachelor´s defences. She obtained also the individual fellowship from DZS.

27. 11 – 6.12. Barbora Šafaříková – Ph. D. student, consultation of heat conductivity measurement and completion of XRD measurements of XRD characteristics of PLA nanocomposites. At the same time, she attended the special lectures for Ph.D. students and bachelor´s defences.

27. 11 – 6.12. Alice Tesaříková – Ph. D. student, detailed acquaints with the cooperation partner institution and team partners, consultation and preparation samples for XRD measurement and evaluation of rheological characteristics PLA mixtures. At the same time, she attended the special lectures for Ph.D. students and bachelor´s defences.

27. 11 – 6.12. Alena Kalendová, Ph.D. – academic staff, discussion about the further cooperation and its form, revision of the work package 2013 and preparing the project documentation with the MUL-KV projectpartner, finalization of the paper for publication, consultation of heat conductivity measurement. Presented lecture at MUL-KV named Nanofillers for Polymer Nanocomposites.

27.11. – 5.12. Marek Koutný, Ph.D – academic staff, discussion about the further cooperation and its form, finalization of the paper for publication, lectur named: Characterization Methods for Biodegradable Polymers.

27.11. – 5.12. 2013 Petr Stloukal – academic staff, discussion about the further cooperation and its form, finalization of the paper for publication.

Supported visits of PhD students and academic staff from Montanuniversitaet Leoben (MUL-KV) at Tomas Bata University in Zlin (TBU-FT):

18. 11 – 17. 12. 2013 Wolfgang Ziegler – master student, detailed acquaint with the cooperation partner institution and team partners, DSC and TGA measurement and evaluation of PLA mixtures,

assistance in biodegradation tests, Lecture named Increase of the thermal stability of polymers based on renewable resources.

10. 12. – 19. 12. 2013 Martin Johannes Begusch – student, detailed acquaint with the cooperation partner institution and team partners. He helped with the DSC measurements and evaluation. He also attended the lectures for Ph.D. students.

10. 12. – 19. 12. 2013 Hannelore Isabella Mattausch – Ph.D. student, discussion about further the form of cooperation, discussion about the XRD results, finalization of the publication, lecture named Influence of Processing on the Property Profile of Polypropylene on the Example of Flame Retardancy.

10. 12. - 19. 12. 2013 Bernd Erwin Haar – student, detailed acquaint with the cooperation partner institution and team partners, discussion about future projects, assistance in biodegradation tests.

Outputs

Master Thesis

Jiří Šmotek. Biodegradovatelné nanokompozitní materiály (Biodegradable nanocomposite materials), master thesis, UTB FT, Zlín, 2013.

Barbora Šafaříková. Kompozity/nanokompozity s pokročilými vlastnostmi (Composites/Nanocomposites with advanced properties), master thesis, UTB FT, Zlín, 2013.

Papers

Petr Stloukal, Alena Kalendova, Hannelore I. Mattausch, Livia Chitu, Sabine Bodner, Guenther Maier, Miroslav Slouf, Marek Koutny. Biodegradace nanokompozitních filmů PLA: morfologie, biodegradace (Biodegradation of PLA nanocomposite films: morphology, biodegradation), *Plasty a kaučuk*, 1-2/2014, p. 11-16.

Petr Stloukal, Alena Kalendova, Hannelore I. Mattausch, Stephan Laske, Clemens Holzer, Livia Chitu, Sabine Bodner, Guenther Maier, Miroslav Slouf, Marek Koutny. Influence of various nanoclay fillers on the biodegradation of polylactic acid, submitted to Polymer Testing.

International conferences

Stloukal, P., Mattaush, H., Pekařová, S., Kalendová, A., Koutny, M.**:** PLA and PLA nanocomposites; the influence of hydrolysis inhibiting additives on biodegradability. European Symposium on Biopolymers - ESBP2013, 7.-9. October, Lisbon, Portugal.

Stloukal, P., Mattaush, H., Pekařová, S., Kalendová, A., Koutny, M. **:** Influence of the filler content and type on biodegradation of PLA films. European Symposium on Biopolymers - ESBP2013, 7.-9. October, Lisbon, Portugal.

Haar, B., Laske, S., Stloukal, P., Kalendová, A., Koutny, M., Bodner, S., Holzer, C.: Morphology and its influence on rheological parameters of nanocomposites filled with layered silicates based on polylactic acid – ANTEC 2014, 28.4.-30.4. April, Las Vegas, USA.

All the main goals of the project planed for 2013 have been achieved. The project has several important outputs: 2 master thesis, 2 papers in scientific journals (one national and one international), 3 conferences. Overall the project may be evaluated as very successful, from the viewpoint of the new partnership link-up, student experiences and further cooperation in a new project, which is in preparation.