3rd International PLASTiCE Conference

Future of Bioplastics

October 1-2\textsuperscript{nd} 2013

COBRO – Packaging Research Institute
Konstancińska 11 Street,
02-942 Warsaw
Poland
You are cordially invited to The Future of Bioplastics conference.

The Future of Bioplastics is the third and final instalment of the annual Central Europe PLASTiCE project conference. PLASTiCE project stands for Innovative Value Chain Development For Sustainable Plastics in Central Europe.

Current universal usage of plastics generates increasing environmental impacts, particularly in the fields of natural resources depletion, production emissions and end-of-life waste management. If we want to control and limit negative effects of those impacts, it is necessary to implement the policy of sustainable development in plastics life cycle. This can be achieved by using bioplastics – plastics that are susceptible to biodegradation and plastics produced from renewable resources.

Despite the current economic crisis the market of bioplastics is developing rapidly and globally known brands invest heavily in their applications. According to plastic industry associations this growth is expected to continue in foreseeable future. The main purpose of the final PLASTiCE conference is to collate and present experiences with bioplastics of industry, enterprises, associations, research centres and European initiatives.

The first day of the conference is an opportunity to present the outcomes of PLASTiCE project both by project partners from Central Europe and supporters from around the globe. Those outcomes focus on popularisation of bioplastics, the concept of sustainable development in plastics and identifying and reducing barriers of bioplastics in their whole life cycle.

Second day emphasises on bioplastic market and industry development. Invited international experts will present current knowledge, new technologies and sustainable growth perspectives of bioplastics, their practical applications and sustainability assessment opportunities which can be used in marketing, PR and product development.

We sincerely hope that the conference will act as a great information exchange medium and will provoke discussions about sustainable development policy and its place in the whole life-cycle of plastics and bioplastics.

Attendance to the conference is free of charge.
Foreword

Dear participants of the 3rd PLASTiCE conference: Future of Bioplastics, let me welcome you to Warsaw and to the intensive two-day program of the conference. The program is designed to inform about the PLASTiCE (Innovative Value Chain Development for Sustainable Plastics in Central Europe) project and give an industrial and academic perspective on the state-of-the-art.

The PLASTiCE project has just entered its last 6 months. This means that project outcomes: information toolkit, the Transnational Advisory Scheme, and the Joint R&D Scheme have already been largely finished. New capacity for bioplastics certification in two countries is close to finalization and reports from case studies that took place throughout the region will be presented.

Our program that was set when we started the project has been largely realized although a hidden, unfulfilled wish still remains: we would all prefer a more pronounced push of Central European companies into the quickly developing and commercially promising area of bioplastics or related sustainable polymers and plastics area. But industrial direction is slow to change as a large ship. However I believe that our project managed to move the steering wheel of the large vessel and in the near future we will see the outcomes of the incessant promotion, dissemination and contacts that the project partners have been carrying out for the last two and a half years.

An added outcome that was not originally planned for is that the project influence has been projected far outside the target area. First by chance but latter through plan we managed to link with national centers of expertise (which we call National Focal Points) that have committed to establish National Information Points through which the message is spread in local languages. Some of our publications are available in Russian and further are being prepared in Arabic. The reach of this activity can only be guessed. But the future is for those that are patient...

This brings me to the future. The PLASTiCE project is ending but partners are committed to upkeep the established forums so it will not come to a full stop. Moreover the project in its modular organization has lessons and messages that will hopefully be taken in by future actions wherever their focus may lie. The highly motivated, inspired and insightful group of experts that were assembled by the PLASTiCE project will surely act as a catalyst for future development.

After all the intensive involvement with bioplastics and sustainability I believe it is safe to say that plastics continue to have a bright future, but we still have a lot to do to improve their sustainability - and truly align them with nature!

Doc. Dr. Andrej Kržan,
PLASTiCE coordinator, National Institute of Chemistry, Ljubljana
About PLASTiCE

The international project PLASTiCE - Innovative value chain development for sustainable plastics in Central Europe started in April 2011 within the Central Europe Programme. It brings together 13 partners from 4 countries (Italy, Slovakia, Slovenia and Poland) that represent the entire value chain from production to waste management and enjoys a strong support from institutions of knowledge.

The PLASTiCE project has as its objective to promote new environmentally friendly and sustainable solutions, particularly biodegradable plastics, in the packaging and end-user industry. This will be achieved through information dissemination and by identifying and removing barriers to the faster and more widespread use of sustainable types of plastic, particularly biodegradable plastics and plastics based on renewable resources, in Central Europe.

Among the most important project objectives are:

- raising awareness among target groups including general public on the issue of biodegradable plastics
- improving technology transfer and knowledge exchange mechanisms with end-user industries
- improving access to scientific knowledge and the use of already existing knowledge as well as adapting it to the requirements of biodegradable polymer and plastics producers
- intensifying application-oriented cooperation between research and industry.

The project is following these objectives by dissemination of information through National Information Points that will be established in all participating countries, as well as through targeted events. We are conducting an analysis of market expectations and case studies of the value chain that will be the basis for the development a Transnational Advisory Scheme and proposing a Roadmap for Joint R&D Scheme, which will to intensify application-oriented cooperation between research and industry.

These actions are tailored, but not limited, to the particular needs of Central Europe with its specific situation The region possesses relatively strong centres of knowledge on biodegradable materials but lags in the application of such materials as well as production and commercial activity linked to them. By joining and combining the R&D potential from different countries this project has a well-rounded scientific support that is being applied to addressing these shortcomings.
Through the combined effect of information, regulatory support and by involving the complete value chain contribution (research, producer, converter, end user) the project will contribute to overcoming current obstacles to the wider use of sustainable plastics use in Central Europe and through the lessons learnt elsewhere as well (www.plastice.org).

Project Partners:
About CENTRAL EUROPE

CENTRAL EUROPE is an EU programme that encourages transnational cooperation among the countries of Central Europe to improve innovation, accessibility and the environment and to enhance the competitiveness and attractiveness of cities and regions.

The CENTRAL EUROPE programme invests € 231 million to provide funding to projects carried out in partnership involving national, regional and local institutions from Austria, the Czech Republic, Germany, Hungary, Italy, Poland, the Slovak Republic and Slovenia.

The CENTRAL EUROPE programme area covers about 1,050,000 square kilometres, an area that is approximately a fifth of the EU landmass. About 148 million citizens or 28 percent of the EU population live in this area.

CENTRAL EUROPE is financed by the European Regional Development Fund and runs from 2007 to 2013. The programme area is characterised by a high population density as well as a high degree of urbanisation, with 73 percent of the population living in cities or urban areas. Its economy shows high disparities with regard to income and living standards: Besides encompassing some of Europe’s richest regions.

CENTRAL EUROPE also includes some of Europe’s poorest ones.

CENTRAL EUROPE aims to contribute to reducing these differences through cooperation between regions, working towards joint solutions to common problems and actions that harness the regions’ potential. The programme should also help to strengthen the overall competitiveness by stimulating innovation and promoting excellence throughout Central Europe.

More information: www.central2013.eu
### Agenda – Day 1  
*(1.10.2013)*

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<td>Session 1: Opening, Plenary lecture, – project PLASTICE</td>
<td><strong>Opening remarks</strong> – Hanna Zakowska / Stanisław Tkaczyk (PL)</td>
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<td><strong>Presentation of the PLASTICE Project</strong> – Andrej Krzan (SLO)</td>
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<td><strong>Central Europe Programme</strong> – Angelika Trochimiak – Joint Technical Secretariat of CENTRAL EUROPE Programme (PL)</td>
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<td><strong>Plenary lecture</strong> – Bio-based Monomers and Polymers: a Route to Sustainable Plastics? Mariastella Scandola (IT)</td>
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<td><strong>Session 2: Project PLASTICE Outputs</strong></td>
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<td>11:50</td>
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<td><strong>Transnational Advisory Scheme</strong> – Greg Ganczewski (PL)</td>
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<td>12:10</td>
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<td><strong>R&amp;D Scheme</strong> – Marek Kowalczuk (PL)</td>
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<td>12:30</td>
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<td><strong>Case Study 1</strong> Use of biodegradable plasitcs in hygiene, sanitary and auxiliary medical products, Andrej Zabret (SLO)</td>
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<td><strong>Case Study 2</strong> Systemic approach for sustainable production of bioplastics – Integrated composting, Marta Musioł (PL)</td>
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<td><strong>Case Study 3</strong> Introduction of biodegradable materials in production processes. Production of twines for agriculture, Irina Voevodina (IT)</td>
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<td>13:00</td>
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<td><strong>Case Study 4</strong> Production of packaging for eggs made from BDPs, Ivan Chodak (SK)</td>
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<td><strong>Session 3: National information Points and International cooperation – Part I</strong></td>
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<td><strong>The National Info Points on Sustainable Plastics</strong> – Maria Grazia Zucchini (IT)</td>
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<td><strong>International Outreach</strong> – Stanislav Miertus (IT)</td>
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<td><strong>Sustainable Plastics in Croatia</strong> – Maja Rujnić-Sokele (HR)</td>
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<td><strong>Present Status And Future Of Sustainable Plastics In Hungary</strong> – Bela Pukanszky, Balazs Imre &amp; Gabor Faludi (HU)</td>
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<td><strong>Session 4: National information Points and International cooperation – Part II</strong></td>
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<td><strong>State-of art of the Sustainable Plastics in Romania</strong> – Raluca Nicoleta Darie, (RO)</td>
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<td><strong>Present Status, Expected Future and Key Initiatives in The Field of Sustainable Plastics in Indonesia</strong> – Pranamuda Hardaning (ID)</td>
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<td><strong>Sustainable Plastic in Serbia, Trends and Challenges</strong> – Branko Dunjic (RS)</td>
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<td><strong>Current research and development in the field of biodegradable polymer materials in the institute of polymers – BAS</strong> – Milena Ignatova (BG)</td>
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<td><strong>Biodegradable Plastics in UK – Past, Present and Future</strong> – Iza K. Radecka (UK)</td>
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Agenda – Day 2

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<td>Bio-based and Biodegradable Plastics – New Members of the Plastics Family – Sabine Lindner (DE) – PlasticsEurope Deutschland e.V.</td>
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<td>Bioplastics Driver For Local Growth – Giulia Gregori (IT) – Novamont</td>
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<td>10:10</td>
<td>New Natureflex Films – Andrzej Kornacki (PL) – Innovia Films</td>
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<td>Biomass for the Future Project – Patrick Navard (FR) – Ecole des Mines de Paris</td>
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**Session 6: Sustainability Assessment**

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<td>Certification of Biopolymers – Miriam Sahl (DE) – DIN CERTCO</td>
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<td>11:40</td>
<td>Experiences on 20 Years of Biopolymer Testing and Certification: Challenges and New Developments – Bruno De Wilde (BE) – Organic Waste System</td>
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<tr>
<td>12:00</td>
<td>LCA of Shopping Bags – Mitja Mori (SLO) – University of Ljubljana, Faculty of Mechanical Engineering</td>
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<td>12:30</td>
<td>Packaging from Renewable Resources – Evaluation of Biobased Content – Hanna Żakowska (PL), Greg Ganczewski (PL) – COBRO – Packaging Research Institute</td>
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<td>12:50</td>
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**Session 7: Bioclean Project**

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<td>Objectives, Activities and Expected Impacts of The FP7 – BIOCLEAN Project – Fabio Fava (IT) University of Bologna</td>
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<td>Obtainment, Isolation and Characterization of Microbes Degrading Petroleum – Based Plastic Wastes and Polymers – Philippe Corvini (CH) – Fachhochschule Nordwestschweiz</td>
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<td>14:35</td>
<td>Biodegradation and Valorization Pathways for Petroleum – Based Plastics and Polymers – Nadia Lotti (IT) – University of Bologna</td>
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<td>Pre-Treatments for Improving Plastic Wastes Biodegradation and Bio-Transformation – Vincent Verney (FR) – Centre Nationale de la Recherche Scientifique</td>
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<td>15:10</td>
<td>Intensified Bioremediation of Plastic Wastes in Composting and Other Surface Disposal Processes – Bruno de Wilde (BE) – Organic Waste System</td>
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<td>Bioremediation of Plastics in Marine Environment and Development of Measures for Mitigating Plastic Pollution in the Aegean Sea – Nicholas Kalogeragis (or Elia Psillakis) (GR) – Technical University of Crete</td>
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**Session 8: The Future**

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<td>Future of CE Programme – Mariusz Kasprzyk (PL) – CE Programme</td>
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<td>16:30</td>
<td>Round Table Discussion</td>
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<td>Conference Closing – Andrej Krzan (SLO) – PLASTICE Project Coordinator</td>
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Media partners

[Logo images]
Nowadays much attention is given to the concept of sustainable development and to the ways how society can achieve it. Among others one of the most evident sustainable routes is a search of alternative resources of raw materials, since the intensive use of mineral resources (oil, coal, gas) results in their significant depletion and negatively contributes to climate changes on the planet. Substitution of oil-based polymers with polymers obtained from renewable resources is seen today as a strategy to control greenhouse gas emissions and to contribute to the development of a sustainable society. The strong interest for such materials is certified by an exponentially increasing number of ‘Green polymeric materials’ being advertised in the web.

Bio-based polymers can be produced from various renewable resources and currently the most used raw materials are carbohydrate-rich products from the agricultural sector. Although the use of agricultural products for non-food applications has raised a debate around possible consequential food shortage, this issue is generally considered devoid of sufficient grounds.

Bio-based polymeric materials can be obtained by different ways, either directly from natural polymers such as polyhydroxyalcanoates, starch, cellulose etc. or via synthetic routes that combine or polymerize bio-based building blocks (lactic acid, succinic acid, propandiol, bio-ethylene, etc.). Though in principle bio-based polymers may find utilization in all areas, the field where the shift from oil resources to renewables is mostly envisaged is packaging, where about 40% of the plastics produced worldwide is employed.

This presentation will provide an overview of polymers and monomers from renewable resources with particular attention to those commercially available or close-to-commercialization.
Recent years a lot of unverified information on bioplastics has entered the market. Also a lot of products are offered as being biodegradable without appropriate testing. This has created mistrust among the end-users to reconsider the use of bioplastics in their production and distribution processes. To build up trust again, it is necessary to deliver a reliable and neutral tool that allows end users to verify what kind of applications could most fit their specific situation.

One of the main outputs of Work Package 4 of PLASTiCE project was to create a Transnational Advisory Scheme about sustainable plastics. This presentations portrays the path the project partners took to create the Scheme and discusses the structure of the Transnational Advisory Scheme itself.
A PROSPEROUS FUTURE FOR ENVIRONMENTAL BIODEGRADABLE PLASTICS
IN CENTRAL EUROPE

From Science to Innovation in the Value Chain

Marek M. Kowalczuk

Polish Academy of Sciences, Centre of Polymer and Carbon Materials
34 M. Curie-Skłodowska St., 41-800 Zabrze, Poland

According to estimations of Global Industry Analysts Inc. the world market for biodegradable polymers could achieve a volume of 1.1 million ton by 2017 [1]. Moreover, between 2014 and 2020 the European Commission will focus research funding, among others, on supporting innovative solutions for biodegradable plastics [2].

The presented roadmap has the aim to support application-oriented cooperation between research institutions and companies in Central Europe in the field of environmentally biodegradable plastics. By bringing together knowledge and competences available in the respective institutions, the roadmap helps to guide producers through the process from research to commercialization of new environmentally biodegradable plastics and their applications. A set of case studies illustrates important issues to be considered when starting the production of environmentally biodegradable plastics and their applications.

References

Acknowledgement

This contribution was prepared within the Work Package 3 of the project Innovative Value Chain Development for Sustainable Plastics in Central Europe (PLASTiCE), co-financed under the Central Europe Programme by the European Regional Development Fund.
SYSTEMIC APPROACH FOR SUSTAINABLE PRODUCTION FOR BIOPOLYMERS – COMPOSTING

W. Sikorska, M. Musioł, G. Adamus, M. Kowalczuk, J. Rydz, M. Sobota
Polish Academy of Sciences, Centre of Polymer and Carbon Materials, 34. M. C. Sklodowska St., 41-800 Zabrze, Poland, wanda.sikorska@cmpw-pan.edu.pl

INTRODUCTION

The unstoppable growth in plastics use has brought with it a growing environmental burden—from the perspective of resource use, emissions released during the production stage, and waste management. The plastics industry in the European Union is represented by more than 59 000 companies—most of them are SME’s—and is generating turnover of around 300 billion euros per year. Although the economic downturn between 2008 and 2012 in the European Union has negatively influenced sales figures in many industrial sectors, the plastics market in Central Europe—after going through a two year depression—is dynamically growing again. The industrial sector with the greatest immediate potential for the use of biodegradable plastics is the packaging sector. However, from the environmental point of view, the disposal of plastics is still of major concern among the European policy makers. Plastics are being applied almost everywhere and the demand for plastics rises year by year. This creates severe challenges for waste management and has a great impact on the environment, since only a small fraction of plastic waste is being recycled. If we want to control and reduce these negative impacts on the environment it is essential that we move to the production and use of plastics with a higher level of sustainability, in particular biodegradable and biobased plastics. On the positive side, Central Europe has a strong scientific base in the field of biodegradable polymers, which needs to be better utilized. [1]

The international project PLASTiCE – “Innovative value chain development for sustainable plastics in Central Europe” is devoted to the promotion of new environmentally friendly and sustainable plastic solutions. The main goal of this Project is elaboration a transnational roadmap for technology transfer from science to biodegradable plastics industry based on a joint R&D scheme. A roadmap for a transnational R&D scheme will allow companies to enter much quicker into a technology transfer process in the future and to relay on the expertise from a transnational team of researchers. The first step of the Project implementation was to map the state of expertise in the participating R&D institutions, to select the companies for the case study and to identify a range of potential biodegradable polymer materials that will be produced and implemented in future processes in Central Europe, including identification of parameters, properties and other requirements. In the second stage, the testing of the joint R&D scheme was carried out in a practical case study. The approach for transnational development and optimization of biodegradable polymer materials and their process applications in close cooperation with the companies engaged in the case study were verified by the research teams. The communication present the results one of the case study 2B “Systemic approach for sustainable production for
bioplastics - Composting”, which concerns mainly the selective organic waste collection and studies of the biodegradation process of plastic packaging.

RESULTS and DISCUSSION

The fruit and vegetable departments of grocery shops and super markets often mixed organic waste with other waste fractions. The idea behind this case study is to set up a separate waste stream process by way of delivering grocery shops and super markets biodegradable waste bags to select organic waste at the source. The main focus went out to the preparation of biodegradable plastic bags, their use in grocery shops and super markets and their (bio) degradation at an industrial composting plant. The Bioerg company produced the special packaging in the form of 35L biodegradable bags for organic waste collection in trade network Społem. The Społem chose two shops as a place for implementation of this case study. Waste bins with the bags were installed near fruit and vegetable departments. The super market staff disposed organic waste to the bins. The composting facility in Zabrze (A.S.A company) received organic waste from the selected stores in order to perform composting process. The composting process of new biodegradable packaging was monitored by macroscopic and microscopic observation of the packaging surface, weight loss of packaging as well as changes of their molecular weight and chemical composition. [2] Waste was collected in the period 01.08-30.09.2012 with a frequency of once a week. The total amount of collected waste was 1280 kg, this means an average of 640 kg of organic waste per month from two stores. The main challenge concerned the storage of the waste bags in the stores, especially in periods of high temperatures outside. On the other hand the increased frequency of waste collection under market conditions would probably be not feasible from the economic point of view for small scale initiatives. These kind of initiatives should be analysed from the point of view of waste collection companies on a larger geographic scale in order to secure economic feasibility in case of high frequency of waste collection (at least once, twice a week), especially in spring and summer. Additionally one of the critical success factors is the full cooperation of the staff.

CONCLUSION

The experiences in the case studies showed that the joint R&D scheme is necessary to initiate a wide cooperation process between all partners in the biodegradable plastics value chain in Central Europe. Some cooperation initiatives highlighted new issues and framework conditions for successful production of biodegradable packaging, implementation of these kinds of packaging under market conditions and selection and final composting of such packaging.

References


SUSTAINABLE PLASTICS MATERIALS IN HYGIENE PRODUCTS
Andrej Zabret, Tosama, Vir, Slovenia, andrej.zabret@tosama.si

Tosama is one of the largest producers of hygiene and sanitary products in Europe. Main products are divided into three groups: Health care, Private label (predominantly tampons) and FMCG; tampons dominate in the private label group. Tosama has its own R&D, QC system and QA system incorporated into each program.

Tosama products are mostly intended for single use - disposable products partially made of plastics and wrapped in plastic packaging. Since most of our products quickly become waste we wish to develop novel products that will have a lower environmental burden and will offer users a wider range of waste management options. We have also noticed a growing interest for more sustainable products in the market. In the first stage of this development we are targeting products where bioplastics can replace conventional plastics and not new products.

A key requirement is the ability to process new materials on existing equipment or that only minor modifications are required.

In collaboration with the PLASTiCE project we focused on implementing bioplastics for two products: tampon applicators and surgical tweezers. In both cases production test were carried out.

- Tampon applicators: (6 materials tested). There are no compostable tampon applicators yet in the market, so no ready materials are available. Key challenges for the injection molded product were the required softness and thin product wall. We arrived to an acceptable prototype on which artificial ageing is currently carried out.

- Tweezers (2 materials tested). Results of the production tests were promising, production was fluent, however established steam sterilization is not compatible with the materials thus requiring further improvements.

Due to specific requirements e.g. sterilization and regulatory requirements the implementation of bioplastics into production of hygiene products is slow, however we estimate it to be feasible.
The Case Study was performed in collaboration with a company that presently produces twines using polypropylene. Since twines are widely used in the agriculture sector, the Company was interested in exploring a shift of starting material from oil-based and non-biodegradable to bio-degradable polymers (both from oil and bio-resources). The environment where bio-degradation had to occur was soil, given the agricultural applications of the produced twines.

The case study started with a literature search on polymers biodegradable in soil, followed by a market search on their commercial availability and price. All materials taken into account as potential candidates were thoroughly characterized using a range of techniques in order to allow final selection of the materials to be processed at the Company’s plant. Two candidates were selected for twine production, based on proven soil biodegradability and commercial availability: Polyester (A) and Polyester Blend (B). The results using Polymer A were encouraging, as the result of the trials, a demonstration twine was produced.
CASE STUDY 4: PACKAGINGS FOR EGGS MADE FROM BDPS

Ivan Chodák, Pavol Alexy, Dušan Bakoš

Polymer Institute of the Slovak Academy of Sciences, Bratislava
Faculty of Chemical and Food Technology STU, Bratislava

When applying BDPs for products made by standard plastics technology, any product made from BDPs suffers either from unacceptable ultimate properties or problems appearing during processing or of both. Price of the material represents usually the third important aspect which must be considered regarding commercial success.

Within Plastice project, special composition based on a mixture of PLA and PHB was developed with ultimate properties being versatile in a broad range, including high toughness demonstrated by high elongation at break. All components of the mixture are fully biodegradable, the material is thermally rather stable, economically close to commodity plastics, and does not undergo physical ageing during storing. Most of standard plastics technologies were tested successfully concerning the processing on semipilot scale, namely compression and injection molding, extruding, and film blowing. More complicated technology, namely vacuum thermoforming, was also successfully performed in laboratory; this technology is ready to be tested in pilot scale for production of packagings for eggs.

The unique properties of the material together with price close to commodity plastics have been achieved by the combination of several biodegradable polymers, with plasticizer and several other additives, including a special compatibilizer.

Slovak patent was applied for the material composition and way of preparation, IP protection by PCT is active and national phase patenting is prepared in a number of countries all over the world. The invention was awarded a gold medal at International Invention Show at Taipei in 2012.

Further development of the blend consists in addition of biobased biodegradable additives making the blend even cheaper without substantial loss of mechanical properties making the material fully competitive with polyolefins also from economical point of view.
National Info Points on Sustainable Plastics are interfaces aimed at stimulating interaction between demand and supply along the value chains in the market of bioplastics in Central Europe. They have been established through the PLASTiCE project in the countries participating in the project: Slovenia, Italy, Poland, Slovakia. The scheme can be easily adopted also by further countries. These National Info Points (NIP) are organized in a way of “one stop shop” providing an easy access to information on sustainable plastics for both industry and general public. All NIPs can be accessed on the web via the www.sustainableplastics.eu portal.
INTERNATIONAL DISSEMINATION NETWORK OF PLASTICE PROJECT.
THE RESULTS AND WAY FORWARD.

Stanislav Miertus

International Centre for Applied Research and Sustainable Technologies (ICARST)
Bratislava, Jamnickeho 19, Slovakia & Trieste, Area SP, Italy
(e-mail: director@icarst.org)

One of the important objectives of the PLASTICE project is the dissemination of obtained results both in the project participating countries (Italy, Poland, Slovakia and Slovenia) as well as in other European and non-European countries. To reach this objective, national information points (NIP) have been created, which disseminate all important documents coming out of the project on the national web sites specifically established for this purpose.

Moreover, to spread out the knowledge gained within the project on European and global level, the PLASTiCE international dissemination network of national focal points (NFP) outside the project participating countries has been set-up. The NFPs have been involved in the preparation of national information points in these countries. This initiative, however is focused not only to the simple transfer of elaborated documents within the PLASTICE project, but should further contribute to: - awareness and capacity building in the field of sustainability of plastics; - harmonization of legislation, procedures, standardizations and certification; - improved environmental impact of plastics in general; - increased interest of scientific, public, political and industrial bodies in this issue. Last, but not least, the adequate dissemination should lead to the preparation and submission of follow-up proposals both within EC programs as well as within bilateral/multilateral - global schemes (especially with countries with emerging economies).

The results of this initiative are briefly presented with the specific focus on Central and East European countries (e.g. Hungary, Croatia, Bulgaria, Romania, Serbia, Czech Republic, Turkey) as well as on the potential to extend this network initiative in the future globally focusing emerging economy countries (e.g. Egypt, Qatar, Saudi Arabia, India, Indonesia, China, etc), where the sustainability of plastics is the issue.
Field of bioplastic materials in the Republic of Croatia is at a very early stage. There are two companies at the market that produce biodegradable films and foils, EcoCortec in Beli Manastir and Weltplast in Split. In its production programme, Eco Cortec has products of three types of biodegradable polymers – PLA, PHA and fossil-based biodegradable polymer, while Weltplast works only with fossil-based biodegradable polymers. EcoCortec and University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, are currently involved in the CIP Eco-innovation project that is being funded by the European Union – MarineClean (Marine debris removal and preventing further litter entry), where one of the main areas of action is the development of plastic packaging material degradable in seawaters. In November 2012 the Society of Plastic and Rubber Engineers (SPRE) held the first conference dedicated to bioplastics. SPRE is also the publisher of plastic and rubber journal Polimeri in which special attention is given to bioplastic materials. The future plans include setting up our national focal and info point about bioplastics. Also, Croatian Chamber of Economy, Industry sector, is planning a strategy regarding bioplastics in the near future.
Following a mild decline as a result of the 2008 financial crisis, the production of plastics increases continuously, and in 2010 it reached the value of 265 Mt worldwide and 57 Mt in Europe. In the same year, European plastics converters processed 46.4 million tons into products, approximately 40% of these being short service life applications, mainly for packaging purposes, resulting in 24.7 Mt of post-consumer waste. Not surprisingly, the related environmental concerns have also increased, strengthening efforts to reduce the ecological effect of polymeric materials. The sustainable production and application of plastics gained more and more importance in recent years. The PLASTiCE programme fit perfectly into this tendency, promoting environmentally friendly, sustainable plastic solutions in Central Europe. Our country report aims to give an overview of the present status of plastics production, processing and application in Hungary, focusing on sustainable solutions with respect to suppliers, converters, legislation and government policies. Various aspects, e.g. renewable resources as well as reprocessing, recycling and composting will be discussed.
STATE-OF-ART OF THE SUSTAINABLE PLASTICS IN ROMANIA

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ICMPP is a new partner in PLASTiCE Project and intends to be an efficient point of information in the Romania region on Bioplastics and Sustainability of Plastics in general. Growing demand for more sustainable solutions is reflected in improving recyclability of plastics as well as growing production capacities of bioplastics.

With only 700 gr of waste generate per person per day, despite the low recycling rates, one can say that Romania is more sustainable than many northern countries that could recycle more in percentage but generate more than twice as much waste per person. Beside manufacturing and using biodegradable plastics in daily life, the challenge for Central and Eastern Europe is about increasing reuse, composting and recycling as much as it is keeping or reducing as much as possible the low levels of waste generation.

Although there are not enough data sources and availability on these topics regarding the situation in Romania, this presentation would like to focus on several important aspects regarding sustainable plastics in our country. Recent achievements, features of the national waste management system, national and regional legislation on plastics, economic and fiscal instruments as well as informative instruments will be presented.

Domestic, regional and international collaboration is highly needed to share knowledge and encourage innovation. Due to the high environmental awareness, several projects with topics on sustainable plastics are founded by national or European founds and others are recently proposed for financing.
Present Status of Environmentally Degradable Plastic in Indonesia

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Statistical data on volume of solid waste in Indonesia has been increasing constantly with population. Based on data from Indonesian Ministry of Environment year 2008, about 40 million tonnes waste was produced, and 14% was plastic waste. Since waste management in Indonesia is mostly carried out through landfill, non-degradable plastic waste makes an environmental problem.

In order to promote environment conservation, the Government issued Act no 18 regarding Waste Management in year 2008. It is stated in verse 15 that the producer is obliged to manage plastic packaging and/or goods that are not able or difficult to degrade in natural environment. Some local private companies then tried to produce environmentally degradable plastics and introduced into the market; such as tapioca starch based plastic, ECOPLAS and ENVIPLAS, as well as oxo-degradable plastic additive, OXIUM and other imported product EPI. In fact, now most modern market in Jakarta and other big cities is using shopping bags contained oxo-degradable additive because of affordable price. To pull the awareness of private companies to environment conservation, Green Label Indonesia (GLI) was firstly introduced in year 2010 by non-government organization, namely Indonesia Solid Waste Association (InSWA). In year 2011, the Government published Indonesian National Standard (SNI no. 7188) regarding Ecolabel Criteria for shopping-bag plastic product. For implementing the Act no 18, the Government has recently issued Government Regulation no 81/2012, regarding Waste Management for Household Waste and Similar Household Waste. According to Verses 15 (1), use of raw material and packaging that are able to degrade in natural environment, able to generate less waste, and able to recycle, as stated in verses 12 to 14, are implemented gradually following the roadmap made by Ministry of Environment.

Research and development on Environmental Degradable Plastic has also been carried out in some universities and government research institutions, such as Agency for the Assessment and Application of Technology (BPPT), Indonesian Institute of Sciences (LIPI), Plastic Packaging Research Institute, Bandung Technological Institute, Gadjah Mada University, Bogor Agricultural University and others. They mostly focus on doing research for utilization of Indonesian renewable bioresources for production of environmentally degradable plastic, as well as development of method for evaluation of plastic degradability.
SUSTAINABLE PLASTIC IN SERBIA, TRENDS AND CHALLENGES

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The presentation will give current overview with production, consumption and management of polymers and polymeric materials in Serbia.

There are two producers of polymers in Serbia, producing HD-PE, LD-PE and PP. Other polymers are imported. Annual consumption of polymeric materials is around 300,000 tons.

Main problems in use of polymeric materials are related to packaging. Serbia has solid legislation in this area, but lacking infrastructure and enforcement of laws. However, after 4 years of adoption of main laws (The Law on Waste Management 2009 and Law on Packaging and Packaging Waste 2009.), there are encouraging results in recycling and re-use of polymers. Almost 90% of all packaging placed on the market is included in collection system, and national goals set by by-law are achieved.

Almost 100% of waste tires are either re-used or incinerated in cement plants.

Since 2008, there is widespread use of oxo-additives in shopping bags, while some municipalities banned use of plastic grocery bags.

Research in the field of polymers has strong tradition, with over than 500 researchers active in the field. Bio-degradable polymers are more and more studied, but mostly for bio-medical applications. There is strong base for possible cooperation with other research groups in the field of sustainable polymers.
BIODEGRADABLE PLASTICS IN THE UK – PAST, PRESENT AND FUTURE

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A major problem of waste and environmental pollution is that plastics produced by the petrochemical industry are not biodegradable and therefore accumulate in the environment at a rate of more than 25 million tonnes per year. Currently in Britain an estimated eight billion plastic carrier bags are discarded, and this figure continues to rise every year. It is not hard to see why the final disposal of such materials continues to pose a growing challenge for authorities at both the local and national level. The need for a fully degradable plastic is pressing.

Bioplastics have experienced fast growth in the past decade thanks to public concerns over the environment, climate change and the rising prices of fossil fuels. Global capacity of bioplastics is expected to reach 3.45 million metric tons in 2020. Starch plastics, poly-lactic acid (PLA) and poly-hydroxyalkanoates (PHA) are expected to be the major types of biobased biodegradable plastics in the future.

Bacterial bioplastic such as PHA can contribute to the solution of the problem of disposal of manufactured plastics. Attempts are therefore now being made to find new ways in which to increase the rate and efficiency of this sort of microbial synthesis. Typically, this requires researchers to explore the various biochemical pathways and study the extraordinary abilities of certain bacteria to synthesise commercially useful and important biopolymers.

Although the bioplastic market remains small compared to that of fossil-based polymeric materials, the significance of bioplastics in the Europe bio-economy is not controversial. An increasing number of plastics manufacturers within the UK are introducing biodegradable materials into their product portfolios supporting the move towards green packaging. UK companies are now employing industrial biotechnology to produce biodegradable food packaging from biological materials rather than petroleum. Also, UK supermarkets have been trialling biodegradable packaging for fruit and vegetables, and actively promoting eco-friendly waste disposal. Consumers are becoming progressively more ecologically aware and their propensity to purchase environmentally friendly products is on the increase, helped by local authority recycling. Biotechnology is also firmly supported by the UK government.
Scattered plastic litter is found in all parts of the world. The utilisation of biological systems for the production of biodegradable materials is becoming important as a solution to the problems concerning non-biodegradable plastic waste and the environment.

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NANOFABRICATION AND CHARACTERIZATION OF NOVEL NANOPOROUS NANOFIBERS FROM BIODGRADABLE POLYMERS/ORGANOCLAY AND AMPHIPHILIC COPOLYMER-G-PLA/ORGANOCLAY NANO COMPOSITES AS MATRIX-PARTNER POLYMER BLENDS BY ELECTROSPINNING

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Novel nanoporous nanofibers were fabricated by electrospinning using NC-1 and various solution blends of NC-1/NC-2 matrix-partner polymer nanocomposites. Chemical structure, thermal behaviors and morphology of nanocomposites and nanofibers were investigated by FT-IR, TGA-DSC, SEM-TEM analysis methods. Both the nanocomposites containing a combination of high responsive functional groups strongly tend to self-assembly via the physical interactions and different complex formations. The average fiber diameters measured for the NC-1 and NC-1/NC-2 samples strongly depend on the applied e-spun parameters and loading the partner-polymer nanocomposites (NC-2). An uniform distributions along the length the cross section of the nanofibers were observed for the NC-1 (202 and 159 nm of means) and NC-1/NC-2 (202 and 180 nm of means) blends samples with 0.6/0.4 volume ratio. These fabricated nanofibers are demonstrated the cross-section hollow nanoporous morphology with unique fine distributions, relatively high content of 100£ and 100-200 nm nanofibers (70-90 %) and nanopore size around 30-40 nm. Fabricated novel nanofibers are related to class of novel biocompatible and biodegradable materials, and can be utilized for a wide range of applications in bioengineering, tissue engineering, nanomedicine, pharmacy and filtration processing.

Introduction

It is well known that scaffolds play an important role in tissue engineering as a matrix for cellular growing, proliferation and new tissue formation [1]. Many researchers reported that the porous structures of biodegradable and biocompatible polymer nanofiber based scaffolds are very important for cell growth. Nano-size pores can be not filtrated the cells, while microporous structures are not adhere the cells [2-4]. The e-spun poly(e-caprolactone) (PCL) based nanofibrous scaffolds are widely utilized in tissue engineering [5-7]. We have been developed a new approach for the synthesis of polymer nanoporous nanofibers by e-spun microtechnology using poly(e-caprolactone) (PCL) and poly(maleic anhydride-alt-1-octadecene)-g-poly(L-lactic acid).
(copolymer-g-PLA) as matrix-partner polymer systems, octadecyl amine-montmorillonite (ODA-MMT) and Ag-MMT clays as catalyst-nanofillers, and various volume ratios of binary polymer blend solutions in DMF/CHCl$_3$. Investigation of the complex multi-step mechanisms in the formation of nanoporous nanostructural fibers incorporated with two types of silicate layered clays such as organoclay and silver salt of MMT clay allow us design and fabricate qualitatively improved new generation of nanofibers with controlled morphology. General synthetic pathways of matrix-partner polymer nanocomposites and fabrication of nanofibers (electrospinning setup) schematically were represented in Figure 1.

**Experimental**

**Materials**

PCL ($M_w = 125,000$ Da, $M_n = 80,000$ Da and PDI = 1.56), commercially available poly(maleic anhydride-alt-1-octadecene), poly(MA-alt-1-OD) copolymer ($M_w = 40,000$ g/mol, density 0.92 g/cm$^3$ and softening temperature -120°C), Na$^+$. MMT (MMT K-10, surface area 220-270 m$^2$/g), octadecyl amine-montmorillonite (ODA-MMT) ((Nanomer 1.30E) with content of octadecyl amine 25-30%, bulk density 0.41 g/cm$^3$, and crystallinity 52.8% (by XRD), L-lactic acid (analytical standard) and AgNO$_3$ (ACS reagent, assay -99%, m.p. 212°C with decomposing) were purchased from Sigma-Aldrich (Germany). Dimethylformamide (DMF), chloroform and all other solvents and reagents were of analytical grade and used without purification.

**Methods**

Synthesis of individual components for the nanofiber compositions includes the following important steps: (1) preparation of PCL/ODA-MMT (3.5 wt %) layered silicate nanocomposite (NC-1) as a
matrix polymer by intercalating/exfoliating the PCL chains between silicate galleries in DMF solution at 80°C for 8 h with intensive mixing in carousel type of microreactor up to formation of homogenous viscose product. Than nanocomposite was isolated by precipitation with ethanol, extracting-centrifuging and drying under vacuum at 60°C; (2) second nanocomposite (NC-2) was synthesized by interlamellar bulk graft copolymerization of lactic acid (LA) monomer onto poly(MA-alt-1-octadecene) as a matrix polymer in the presence of ODA-MMT (3.5 %) as a catalyst-nanofiller in LA solution under vacuum (600 mm/Hg) at 80 – 0.1°C for 6 h using a special constructed microreactor supplied with Dean-Star unit; (3) the matrix polymer (NC-1)-partner polymer (NC-2) solutions (5 mL for each system with 20 % concentration) were prepared by intensive mixing in DMF and CHCl₃ solutions at 40 and 80°C, respectively, up to fully homogenization and form viscose liquids; (5) NC-1/NC-2 blend solutions with various volume ratios (9:0, 9:1, 8:2 and 6:4) were prepared by intensive mixing for further utilizing in electrospinning processing.

NC-1/NC-2 nanofibers were fabricated by electrospinning method using various volume ratios of solution blends of matrix-partner polymer layered silicate nanocomposites. To prepare nanofibers, electrospinning was performed using the following operational parameters: a syringe pump with a 21-gauge needle (NE 300, New Era Pump Systems) was fixed vertically to obtain a steady flow at a flow rate from 0.2 to 3.0 mL h⁻¹; a high voltage (Gamma High Voltage Research, Ormond Beach, FL) of 6–25 kV was applied at various distances of 8–25 cm between the tip of the needle and the grounded collector. Nanofibers from NC-1 and NC-1/NC-2 solution blends with different volume ratios (0.9/0.1, 0.8/0.2 and 0.6/0.4) in DMF/CHCl₃ were fabricated in the optimized e-spun conditions.

**Characterization**

The Fourier transform infrared (FT-IR) spectra of nanofiber webs (thin films) were recorded on a Thermo-Nicolet 6700 spectrometer in the range of 4000-500 cm⁻¹ with a resolution of 4 cm⁻¹. The surface morphology of the nanofibers were examined using SEM (JSM-6400 JOEL) with scale 1 and 10 µm, magnification x 1.000-50.000 and an acceleration voltage of 20 kV. All specimens were freeze-dried and coated with a thin layer of gold before testing. The average diameter of the fibers were calculated by measuring SEM images of a hundred individual fibers with Image J software (NIH, Bethesda, MD) for each sample.

TEM internal images were obtained using a JEOL JEM-2100F instrument with an acceleration voltage of 200 kV and emission current of 146 mA. This method allowed higher resolution images due to the decrease in wavelength. An electron gun emitted an electron beam which moved through a condenser aperture and then bombarded the specimens. The TEM specimens were cut at room temperature using an ultra microtome. Thin specimens, 50–80 nm, were collected in a trough filled with water and placed on 200 mesh copper grids.
Thermogravimetric (TGA) and differential scanning calorimetric (DSC) analyses were performed using EXTRAR600 TG-DTA6300 and Diamond DSC Perkin Elmer Thermal Analyzers and a linear heating rate of 10°C/min under nitrogen flow. Samples were measured in a sealed alumina pan with a mass of about 10 mg.

Results and Discussion

To obtain stable and beaded free nanofibers the electrospinning parameters including polymer concentration, voltage, flow rate, distance between the tip of the needle and collector were optimized. The optimal conditions for the fibers and their distribution parameters were summarized in Table 1. Choice of solvent and concentration of polymer solution are important factors in terms of production of stable fibers in electrospinning process. Since we added DMF to chloroform, which increased the conductivity of the polymer solution and electrospinability of the solution was improved. The SEM analyses of the e-spun nanofiber webs and their diameter distributions, as well as effect of partner polymer nanocomposite on the morphology of fibers were investigated.

Table 1. Optimized electrospinning conditions and average size distribution (mean) of nano fibers from PCL/organoclay (NC-1) and its solution blends with poly(MA-alt-1-octdecene)-g-poly(L-lactic acid)/Ag-MMT clay (NC-2) at constant concentration of polymer matrix-partner nanocomposites (20 %).

<table>
<thead>
<tr>
<th>Composition of nanofibers</th>
<th>Volume ratio (mL)</th>
<th>Applied voltage (kV)</th>
<th>Collection distance (cm)</th>
<th>Flow rate (mL h⁻¹)</th>
<th>Mean (nm)</th>
<th>Content (%) of fibers (nm) 100 £</th>
<th>100-200</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCL/ODA-MMT (NC-1)</td>
<td>0.6/0.4</td>
<td>6.5</td>
<td>12</td>
<td>0.15</td>
<td>202</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>PCL/ODA-MMT (NC-1)</td>
<td>0.6/0.4</td>
<td>8.0</td>
<td>15</td>
<td>0.20</td>
<td>159</td>
<td>8.0</td>
<td>64</td>
</tr>
<tr>
<td>NC-1-Copolymer-g-PLA</td>
<td>0.6/0.4</td>
<td>6.0</td>
<td>10</td>
<td>0.25</td>
<td>212</td>
<td>37</td>
<td>22</td>
</tr>
<tr>
<td>PCL/ODA-MMT-NC-2</td>
<td>0.9/0.1</td>
<td>6.0</td>
<td>10</td>
<td>0.25</td>
<td>303</td>
<td>4.5</td>
<td>31</td>
</tr>
<tr>
<td>PCL/ODA-MMT-NC-2</td>
<td>0.8/0.2</td>
<td>6.0</td>
<td>10</td>
<td>0.15</td>
<td>186</td>
<td>27</td>
<td>34</td>
</tr>
<tr>
<td>PCL/ODA-MMT-NC-2</td>
<td>0.6/0.4</td>
<td>7.0</td>
<td>10</td>
<td>0.30</td>
<td>202</td>
<td>5.0</td>
<td>43</td>
</tr>
<tr>
<td>PCL/ODA-MMT-NC-2</td>
<td>0.6/04</td>
<td>8.0</td>
<td>10</td>
<td>0.30</td>
<td>180</td>
<td>12</td>
<td>48</td>
</tr>
</tbody>
</table>

The obtained results were illustrated in Figure 2 for the PCL/ODA-MMT clay (NC-1) nanofibers and their visualized nanoporous structures at higher magnification (Figure 3). All nanofibers show cross-section hollow nanoporous morphology with fine distribution of uniform multi-pores with nano-scale size around 30-40 nm. One the other hand, the formation of hollow structures in the phase separation processing associated with Kirkendall effect as shown in Figure 3.
Figure 2. SEM micrographs of the e-spun PCL/ODA-MMT (3.5 %) nanofiber with cross-section morphologies and their diameter distributions. Effect of e-spun parameters.

Comparative analysis of nanofiber images at x 20,000 magnification and higher magnification for the visualization of nanoporous structures (Figure 4) is also confirmed the effect of partner polymer. It was observed that in increasing the concentration of partner polymer (NC-2) not only the fiber diameter reduced, but also the fiber morphology, porosity and distribution of diameters improved. In this way more uniform nanofibers was obtained. The best nanofibers obtained for the PCL/ODA-MMT clay (NC-1) and its blends with 60/40 (v/v) ratio of DMF/CHCl₃ solutions. The best concentration of PCL/organoclay and PCL/ODA-MMT-Copolymer-g-PLA/ODA-MMT blends is 20 % to gain stable polymer jet.

Figure 3. Nanoporous structures of PCL/ODA-MMT clay nanofibers at higher magnification. Kirkendall effect.

Figure 4. Comparative SEM morphology analysis of NC-1)/NC-2 nanoporous nanofibers. Effect of NC-2 loading (0.9/0.1, 0.8/0.2 and 0.6/0.4 v/v) at high magnifications.
Effect of volume ratios (v/v) of NC-1/NC-2 (0.9/0.1, 0.8/0.2 and 0.6/0.4) on the NC-1/NC-2 nanofiber morphology was also investigated. Agreeing with these morphology images (Figures 5–7), fiber morphology and distribution parameters significantly improved by increasing in loading of partner polymer (NC-2) containing ODA-MMT and multi-functional group sites which can be easily interacted with matrix polymer (NC-1) in situ processing, and therefore, essentially accelerate the phase separation process in formation of nanofibers. The best nanofibers obtained for the PCL/ODA-MMT clay (NC-1) and its blends with 60/40 (v/v) ratio of DMF/CHCl₃ solutions. The best concentration of PCL/organoclay and PCL/ODA-MMT–Copolymer-g-PLA/ODA-MMT(or Ag-MMT) blends is 20 % to gain stable polymer jet.

Conclusions

We have developed a facile and effective strategy for design and synthesis of biocompatible poly (MA-αl/l-octadecene)-g-PLA/Ag⁺-MMT clay nanocomposite as a partner component for the fabrication of high performance nanoporous nanofibers by interlamellar graft copolymerization of L-lactic acid onto maleic anhydride amphiphilic copolymer in the presence of Ag⁺-MMT as catalyst-nanofiller. Nanofibers with unique fine distribution parameters were fabricated using biodegradable PCL/organoclay nanocomposite as a matrix polymer by electrospinning at optimizated e-spun parameters. We demonstrated that matrix and partner polymer containing
physically and chemically responsive functional groups tend to strong self-assembly through the formation of the various complexes in the blend solutions which take place an important role in mechanism of the formation of nanofiber webs, especially in the phase separation processing. It was observed that in increasing loading partner polymer nanocomposite significantly improved the morphology and thermal behaviors of nanofiber webs. Thus fabricated novel nanoporous nanofibers are utilizable for widely applications in bioengineering, pharmacy, nanomedicine, nanomicrobiology, water purification, filtration and other engineering processing. These topics will be our future investigations in nearest years.

References


“BIO-BASED AND BIODEGRADABLE PLASTICS – NEW MEMBERS OF THE PLASTICS FAMILY”

Dr. Sabine Lindner
PlasticsEurope Deutschland e.V.

The term “bioplastics” covers plastics made from renewable resources (bio-based plastics), including plastics that biodegrade under controlled conditions at the end of their use phase. Biodegradable plastics may be derived from renewable resources such as starch, but may also be derived from fossil feedstock, e.g. polycaprolactone.

The lecture will focus on the driving forces, market framework and definitions of bioplastics and will highlight bio-based polymers (their main feedstock, intermediates and polymers as well as examples and applications) and biodegradable polymers (their value and developments and some examples and applications). Other issues cover the end-of-life options and the challenges and opportunities for this new family of plastics.

PlasticsEurope welcomes and supports all innovations which enable plastics products to meet the required high quality performance and recommends that the environmental claims such as biodegradability, compostability or the bio-based content are in compliance with appropriate standards such as ISO 14021. We therefore support the application of recognised compostability standards (EN 13432, EN 14995) dealing with the biodegradability of compostable plastics in specific and well defined industrial composting environments. Only products that meet the above-mentioned standards should be labelled compostable, or biodegradable in the specific environmental conditions defined by the EU standards (i.e. “biodegradable in industrial composting”, “biodegradable in soil” etc.).

It must be underlined that market requirements will remain a determining factor in choosing the plastic grade with the desired property profile. The choice is therefore directly related to the functionality and not to the raw material base of the plastic which can be either fossil or bio-based.

For details please visit:


1 ISO 14021: Standard “Environmental labels and declarations - Self-declared environmental claims” (Type II environmental labelling)
2 EN 13432: Standard “Packaging - Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging” is an European-accepted testing scheme which defines the compostability of packaging and describes test methods to determine the biodegradation of polymers in the timeframe of industrial composting systems
3 EN 14995: Plastics - Evaluation of compostability - Test scheme and specifications
BIOPLASTICS DRIVER FOR LOCAL GROWTH

Giulia Gregori

Head of Corporate Communication & Strategic Planning at Novamont

The presentation will focus on highlighting the state of play of bioeconomy in Italy with industrial example of cutting edge technologies and biorefineries being developed by Novamont. Added value products such as bioplastics offer in fact a tremendous opportunity for Italy and Europe to focus production on niche market capable of triggering local growth in areas affected by the current crisis. Inactive and non competitive sites are being converted in biorefineries in several regions across Italy, giving the opportunity to re absorb existing work force and profuse a culture of incremental innovation in the local areas. Case studies will hence be presented showcasing how bioplastics is capable of responding not only to societal challenges in terms of waste prevention but is also acting as a primer for local partnership between industries and farmers hence enabling the creation of new value chain. The main outcome of a publication recently launched at the European Parliament in Brussels will also be resealed in preview.
A FRENCH INITIATIVE FOR TAILORING PLANTS TO NON-FOOD APPLICATIONS: THE BIOMASS TO THE FUTURE PROJECT

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The project BFF project aims at developing new varieties and new agriculture systems for miscanthus (in northern France) and sorghum (in southern France), tailored to improve dry mass productivity while keeping a low environmental impact and adapted to industrial applications.

This ca30M€ project brings together a very multidisciplinary consortium from system modelisation and biology able to « design » the best plant architectures to materials scientists developing new applications. The whole project will participate to the development of local green economy, taken care of by land management teams, through the use of low productivity or polluted lands.

After a brief presentation of the project, we will give some examples of the methods developed for assessing the influence of genotypes on the properties of miscanthus-filled polymer composites.
CERTIFICATION OF “BIOPOLYMERS”

Dipl.-Ing. Miriam Sahl
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Sustainable resources are becoming more and more important for the polymer, packaging, and other industries using artificial or natural materials. The market, the customers, and the public opinion ask increasingly for materials and products, that do not exploit fossil resources, like e. g. gas, oil, coal, etc. Therefore, it is widely necessary for producers to prove, that these fossil carbon sources are replaced by bio-based carbon sources, or that the materials are compostable, respectively. As consumers/users can not identify these properties just by looking at the product, independent proofs and labelling are required.

DIN CERTCO is a certification body offering the certification for “Products made of compostable materials” and “Biobased Products”. The certification is done on the basis of international standards; the resulting certificate is a proof that the product or material meets the requirements of the corresponding standard.

In the field of the certification of “Products made of compostable materials” DIN CERTCO can confirm the suitability of a product or material for composting in an industrial composting plant (based on the DIN EN 13432 alone or in combination with ASTM D 6400, DIN EN 14995 and/or ISO 17088 standard) or for home composting (based on AS 5810, “DIN-Geprüft mark). Regarding the industrial composting we award the “Seedling” mark as well as the “DIN-Geprüft” mark. Compared to the “Seedling” mark the “DIN-Geprüft” mark can additionally prove the compliance with the Australian Standard AS 4736 and/or ISO 18606.

In this presentation, we introduce our company profile and the possible ways of the certification of “biopolymers”, either biodegradable, biobased, or both. Get up-to-date with the latest standard revisions and therefore, the latest bases of assessment in the world of certification.
EXPERIENCES ON 20 YEARS OF BIOPOLYMER TESTING AND CERTIFICATION:
CHALLENGES AND NEW DEVELOPMENTS
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This presentation will start with an overview of the different norms on industrial compostability and will make the distinction between biodegradability and compostability. Next, different aspects playing a considerable role in determining the correct set of tests will be tackled. Aspects like concentration of individual components, variations in composition, use of masterbatches and inks, but also the value of certification schemes, by-laws and positive lists will be discussed. Also some suggestions will be formulated how to further improve the system and make it more efficient and cost-effective.

Currently, 6 major certification systems exist worldwide with regard to compostability: DIN CERTCO, Vinçotte and European Bioplastics (Europe), BPI (USA), JBPA (Japan) and ABA (Australia). These systems are all based on the same international standards (EN 13432, ASTM D6400 and ISO 17088) with similar requirements, but nevertheless show some minor and sometimes relevant differences. Some make a difference between materials and products, others require more testing and some others have also systems for the certification of individual additives for compostable products.

Finally, also some other environments will be discussed, sketching the similarities and the differences which are mostly related to temperature and microbial population. More in particular, biodegradation in home composting, soil and fresh and marine water will be discussed, as well as biodegradation in anaerobic digestion and landfill conditions, with again focus on test methods as well as criteria. Also a brief overview will be given on the standards existing in these fields.
In the paper the life cycle assessment study of four types of grocery bags is presented. Reference bag is low density polyethylene (LDPE) bag, long life polypropylene (PP) and two biodegradable bags from mater-bi and polylactic acid (PLA) are compared to reference bag in terms of environmental burdens and energy consumption. Inventory analysis was done in cooperation with bags manufacturers, merchants, waste management companies and policy guidelines and laws. Environmental impacts are presented with environmental indicators by CML 2001 standard. Study was made for all life cycle stages with different scenarios in the end life stage and main contributors to environmental burdens are identified through life cycle stages. Since is it shown that end of life stage of plastic bags is very sensitive and depended of customer’s behavior, guidelines for disposal of bags are given in the form of percentage increase/decrease of specific environmental indicator. It was found out that bioplastic bags have some advantages in the production life cycle phase (from cradle to door), but can be questionable in the end of life phase if bioplastic is composed industrially.
PACKAGING FROM RENEWABLE RESOURCES – EVALUATION OF BIOBASED CONTENT

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One of the paths that scientist develop focuses on materials from renewable resource. Those materials are produced from plant based sources and are characterised with beneficial ‘carbon footprint’ levels and at the same time do not need non-renewable resources containing so called ‘old-carbon’ to be used in production. This is due to the fact that plant organisms contain chlorophyll which absorb CO₂ from air needed in the photosynthesis process and emit oxygen. This phenomena results in decrease of CO₂ amount in air and in some sense it limits the global warming effect. The goal of this research is to develop a scoring system for renewable resources content in packaging materials. It seems to be justified to implement such system through voluntary certification that can be regulated by COBRO, which should be based on the following points (similarly to German and Belgian system of analogous kind) results of ‘new carbon’ content by the ¹⁴C method. Using this method the renewable resources content in packaging materials can be determined.
Plastics are a fellow traveller of modern life with whom we have an ambivalent relationship: we love the convenience of plastics but hate them for polluting our environment. Newly developed “bioplastics” are biodegradable or made from renewable resources, to make use of plastics more sustainable. PLASTiCE promotes a joint research scheme that exposes producers to the possibilities of the new plastics while also creating a roadmap for actions that will lead to commercialisation of new types of plastic.

www.plastice.org