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Research area: Process aims

Paper and paperboard production // Stock preparation

Key words:

Microfibrillated cellulose, biopolymers, compounds, thermoplastic starch, fibre composites

TITLE:

Preparation of masterbatches containing fibres and biopolymers for the development of novel bioplastics and paper materials

Background/Problem area

Natural fibres are common reinforcement in composite materials. The reinforcement effect depends on the aspect ratio and is superior in microfibrillated cellulose (MFC). MFC can be prepared by mechanical disintegration of plant fibres down to their building blocks. But their fibre matrix interaction in composites is often poor, because of their hydrophilic nature. This inhibits the use of their full reinforcement effect and a wide-spread application.

In contrast to bioplastics, paper fibres are not only reinforcement but the main component of the material. One drawback of fibre networks in paper is that the structure and bonding in the web do not allow plastic moulding as known from plastics because the melting point is above the decomposition temperature. However MFC and compounds based on MFC have also a high potential to improve the strength properties of paper because of their high specific surface area and their interaction with common papermaking additives. The most commonly used dry strength additive in papermaking is native and modified starch. But starch and starch blends are widely used also in bio-plastics. For this reason masterbatches based on MFC and biopolymers like starch and their blends could be used in papermaking in order to improve the paper properties.

Profitably in this context is the fact that MFC can be produced in a conventional co-rotating twin-screw extruder. It can also be assumed that this process involves not only mechanical decomposition, but also a change in the molecular structure of the cellulose. There are still open questions how those processes can be used to modify the fibres more specifically in order to use the full reinforcement potential of the fibres, whilst adjusting the hydrophobic to hydrophilic properties.

This problem will be solved by a cooperation of three research institutes: Papiertechnische Stiftung (Pulp and Paper Institute Heidenau, PTS-IZP), Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT and Albert-Ludwig University of Freiburg, Institute of Earth and Environmental Sciences (Chair of Forest Biomaterials).

Objectives/Research results

The objective of the project is a target-oriented fibrillation of fibres during the treatment in a twin screw extruder in order to find an optimal aspect ratio of the fibres and more precisely also to produce MFC with an optimized interface interaction.

If the bonding properties of the fibres come closer to the interactions found in bio-plastics, there is the chance to develop new paper-based materials with radical new strain-elongation properties, dimensional stability and barrier properties. It should be sufficient if a minimum amount of bio-polymers can be immobilized in the fibre contact area or in the fibre wall itself, or thermoplastic starch or blends are added directly.

In order to demonstrate the general feasibility, bio-polyethylene will be evaluated as representative of polyolefines and thermoplastic starch, which are used in both bio-plastics and paper.

Application/Economic benefits

The project aims to support the SME in the plastics industry in developing innovative packaging materials with a high amount of sustainable raw materials. In the papermaking industry new products can be developed for emerging markets also in the field of packaging. Here properties like plastic mouldability and high rigidity can be used to extend the application spectrum of paper products. Furthermore the project supports the supplying industry of starch and bio-polymers with a new market opportunity.

Period of time: 01.01.2014 – 31.12.2016

Remarks

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