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Research area: e.g. Product aims

Paper, paperboard and board // Packaging papers and paperboard

Key words:

Packaging, paper volume, residues from food production

TITLE:

Increasing the specific volume of packaging papers at constant strength properties through effective use of fiber substitutes

Background/Problem area

The most important properties for packaging carton include the specific volume/density and the strength properties, especially the bending stiffness. In the paperboard manufacturing process, a high bulk is desired, to reduce transport costs. The strength properties may not be impaired, however. Results of preliminary tests have shown that the use of residues from food production in the papermaking process instead of cellulose-based fibres ("fiber substitutes") offers the potential to increase the paperboard specific volume. These residues are currently used mostly as animal feed or for energy production. It is still unclear how residues from food production processes can be economically used in paperboard production, particularly in the manufacture of multilayer folding boxboard. To be considered are mainly the way of treatment or chemical modification of the residue materials for the production of fiber substitutes, their handling in the papermaking process and the optimum use of the potential for increasing the specific volume, for improvement the drainage behavior and ensuring the binding forces necessary for a sufficient structural strength.

Objectives/Research results

The aim of the project is to develop an economical process for the effective use of residues from the production of food (cereal straw, oat husks and rice husks) as fiber substitutes in the production of multilayer folding boxboard. Important subtasks are to exploit the potential to increase the specific volume and to improve the drainage behavior, to ensure a sufficient structural strength by use of the modifiability of the raw materials, to use the cost reduction potential and to contribute to the preservation of resources. A systematic approach to the economic, efficient processing of residues from food production for use in the paper industry shall be developed. The results shall demonstrate that the use of residue-based fiber substitutes for board production is economically viable. The options to change the microstructure of multilayer paperboard targeted to a high specific volume shall be systematically investigated. As fiber substitute materials will form only weak bonding forces to cellulose fibers, systematic studies shall be carried out to activate the binding forces.

At first, residues of food production processes suitable for the production of fiber substitutes were selected and characterized in detail. Based on the results suitable modification methods and recipe components for laboratory sheet forming were selected. The goal was the compliance with the specifications for the sector "multi-ply boxboard". Subsequently, extensive laboratory tests for mechanical treatment and chemical "activation" of the residues were carried out in order to provide fiber substitutes with enhanced binding capacity. Using the modified fiber substitutes, extensive laboratory sheet formation experiments were carried out. Type, particle size and shape, modification process and the dosage amounts of the fiber substitutes and additives were varied. The aim was to build up a very voluminous paper microstructure, while retaining the strength properties. In addition, the influences on the papermaking process were studied (possible effect as detrimental substances) and the maximum amount of fiber substitutes was exploited. The handsheets were assessed regarding their paper relevant standard properties to determine the influence of type and amount of the fiber substitutes used. In the next step, the properties relevant for forming and processing of the paperboard were examined. The influence of the calendering parameters (temperature and pressure) on the microstructure of three-layered handsheets was assessed and their creasability and foldability was determined. SEM micrographs were used to assess the tendency for fracturing and delamination. The results were used for further paper optimization trials in laboratory scale in order to reach the specifications of multilayer folding boxboard. Recycling trials were carried out with the handsheets to examine the sustainability of paper materials containing fibre substitutes. Based on the results of the laboratory trials, greater amounts of the best variants of the fibre substitutes were produced from straw and oat husks in pilot scale, characterized and used in trials on the pilot paper machine to show the transferability to continuous paper production. The characterization of the paper machine samples, cost calculations, benchmarking and further work to assess the sustainability are under progress.

Application/Economic benefits

The results of the research project shall give the opportunity to produce packaging materials with significantly lighter weight than conventional folding cartons – with equal strength properties – by targeted development of a voluminous microstructure of multilayer cardboard. Through the development of customized methods for the activation of binding forces in residues of food production, these may be used as fiber substitutes for paperboard production the first time efficiently and economically without compromising the strength properties. In the course of the development work, the responsible use of the natural resources plays a crucial role. The focus lies on the use of renewable raw materials, based on residues from crop production. This provides a significant contribution to sustainability through increased value and saving resources. The work is in line with the objective of the CEPI Strategy Paper "2050 Roadmap to a low-carbon bio-economy". By using an holistic ecological approach to the use of residues of food-production, new business areas for SME are conceivable.

Period of time: 01.12.2012 – 30.11.2014

Remarks

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