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Research area: Product aims
Paper, paperboard, and board // Packaging papers and paperboards

Key words:
Packaging paper, microfibrillated cellulose, nanocellulose, stiffness

Title: Improvement of strength and stiffness of paper by application of microfibrillated cellulose

Background/Problem area

The mechanical properties of packaging materials are direct connected to the protective function. Both branches production of packaging papers and their converting ask for higher demands as you can see on the cost pressure in due to the high energy and raw material costs and the required mechanical properties at low grammage. The existing methods like bulk application of starch to increase the strength properties are exhaust, because the addition of is limited to 1-1.5%. Also the refining of for example recycled pulp can not help to meet the required properties, because this makes only sense for the long-fibre fraction. Besides this the special high strength and stiffness properties of cellulose microfibrils makes them very attractive for preparation of light-weight packaging papers. Until now suitable processing steps are not yet investigated to transfer these properties in paper structures.

Objectives/Research results

The aim of the research project is the development of processes to integrate cellulose microfibrils in base papers in order to reduce the fibre raw material content of light-weight packaging papers. The objective is to reduce the grammage of packaging papers by 15% while saving the mechanical properties under cost competiveness restrictions. Different types of microfibrils where characterized in terms of chemical properties intrinsic viscosity, elementary composition and molecular weight. These properties reflect the preparation procedure and different behaviour of the microfibrils. SEM images and light microscopy images supported the results, where some particle-like materials where in the range below 500 nm and where more fibril-like samples have diameters even under 200 nm. The best strength improvement was achieved with fibrillated cellulose structures whereas particle-like cellulose had no significant effect on strength or suspension properties.

In the light of the results, the conclusion of this study was that the degree of fibrillation and homogeneity of the fibrils of unmodified cellulose are decisive for its efficacy. The degree of fibrillation and thus the available surface area ultimately determine whether or not the celluloses will behave like secondary fines or will bring about a substantial improvement in strength. As far as the dewatering behaviour is concerned, it was observed that dewatering became poorer together with the degree of fibrillation. It was possible to compensate for this by applying a coating of cationic starch. In colloid chemical terms, the dissolved cationic starch acts like a polyelectrolyte, thus shielding or screening the negative charge of the fibres due to the cationic charge. This in turn compresses the swelling hydrogel layer at the boundary layer of the fibres. In addition, the fibrils are firmly embedded in the starch layer and are no longer free to move in the pulp suspension, thus impairing dewatering.

As the results have shown, the use of finely fibrillar cellulose has enormous potential for saving raw materials, since strength was improved whilst specific volume remained constant. For instance, an increase of more than 20 % was achieved in a BEKP as a function of an additive, modification and fibrillation degree of the celluloses.

Application/Economic benefits

During the research project light-weight papers are produced with special stiffness properties. This can help to protect high added-value consumer goods from mechanical damage with comparatively convenient paper based packaging.

The preparation of cellulose microfibrils with defined properties with potential to reinforce the paper structure in common paper processes has the potential for a new class of additives. These cellulosic-based additives can probably act as carrier for other additives. An application of cellulose fibrils will only be successful under consideration of the different suspension properties and retain of their structural properties. The main innovation will be the connection between fundamental and applied research, where the relation between structure and property of the microfibrils will be used for efficient application processes.

Project period: 01.09.2008 – 31.08.2010

Remarks

The research project IGF 15707 BR is being funded by the German Federal Ministry of Economics and Technology BMWi and is being performed together with the Competence Center Polysaccharide Research at the Friedrich-Schiller-Universität Jena.