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Research area: Product aims

Paper, paperboard and board // Graphic papers

Key words:

Microrobotics, fibre bond strength measurement, fibre bond and network modelling, paper strength improvement, grammage reduction

TITLE:

Enhancement of Fiber and Bond Strength Properties for Creating Added Value in Paper Products (PowerBonds)

Background/Problem area

Significant research efforts have been undertaken in recent years to reduce energy and raw material consumption in paper making while maintaining the constant mechanical and optical properties. In this respect, reducing grammage (the basis weight) of the paper products at a given thickness, in other words decreasing paper density, is a potential area for improvement. A reduction in paper grammage offers means for cutting paper and board manufacturing costs and ensuring production sustainability.

There are many known challenges associated with the grammage reduction. In printing papers, the web stiffness and the strength reduce with a decrease of grammage. Another problem in the grammage reduction is the loss of opacity influencing the visual perception of printed products. To maintain sufficiently high opacity, the amount of pulp fines and mineral fillers need to be increased in the paper furnish. Some of these particles can reduce the number of effective bonds in the sheet and therefore, decrease the strength even further. The largest challenge, however, is that the role of the strength itself in the paper performance in end-use applications is not well understood.

Objectives/Research results

Understanding the importance of strength and taking steps towards reducing the grammage based on this understanding therefore is the primary goal in this project. To achieve the projects aim the project partners combine microscopic characterization tools, novel experimental techniques working at a microscale, simulation tools and advanced pulp-processing technology in order to address the outstanding challenge of understanding the paper strength and its role in paper making. Furthermore a detailed particle level modelling approach is used to capture the very nature of the paper – the stochastic network structure – and to support the materials design by exploring a much greater parameter space than pilot machines can provide. Innovative characterization tools are used to reveal the details of fibres, fibre bonding and the structure of paper. The advanced experimental tools, such as nano and micro-tomography, AFM and ESEM, and micro- and nanorobotic technologies enable the fibre scientists to characterize mechanical and morphological properties of fibres and fibre bonds. In addition to the efforts in developing new models and characterization tools, the project aims to improve the fibre strength and bonding capabilities using novel mechanical and chemical fibre modifications.

Application/Economic benefits

This project aims at *new products* by improving the strength and bonding capabilities of fibres. As the improved strength and bonding capabilities of fibres will allow the reduction of fibrous raw material use and starch consumption, and increase in the filler content while still ensuring an excellent performance of paper products, costs can be reduced.

Furthermore, an increase in paper strength has a huge influence on the productivity as well as on the profitability of paper mills. One paper break in a paper machine causes 20-60 minutes downtime and costs from 6.000€ and above. It is not unusual to see some paper machines suffering from 6-9 breaks a day. Thus, a reduction of web breaks increases the output of a production line, reduces the consumption of raw material and energy and improves the paper quality due to a lower variability. Due to large production volumes, saving of only 10 € per ton by resolving the runnability issue for high-end graphics paper translates into 4 millions € profit for a medium size paper machine having a 400.000 ton annual capacity. In a pressroom, on the other hand, the cost of a single break sums up to a lower value (about 1.500 €) but yet the accumulated cost of all the breaks is still immensely high.

Increasing the bonding strength in fibre-based materials will also help to overcome intrinsic mechanical weaknesses in comparison to other, less sustainable, materials. This approach has to be performed by ensuring in parallel the printability and the optical properties of papers. Paper and board have an overall lighter footprint on the environment, better consumer perception, and are on the long term more sustainable, being based on renewable resources, while competing materials are fossil-based.

Period of time: 01.02.2012 – 31.01.2015

Remarks

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