**Title:**
Improved fibre-additive interaction

**Background /Problem**
To achieve the desired product characteristics of high-quality graphic or specialty papers, it is usually necessary to add product or functional additives such as dry and wet strength agents, dyes, optical brighteners or sizing agents. Their various interactions with fibres lead to the development of paper properties such as dry and wet strength, hydrophobicity and optical characteristics. Further, these additives improve the runnability in the paper machine and lead to the desired converting characteristics of the different paper grades, thus ensuring the paper products meet the quality demands of converters and consumers. The interactions between functional additives and beaten fibres are particularly important as these components are decisive for the production costs of paper.

To maximize the specific changes in paper properties obtained by a given amount of active substance introduced by functional additives, the additives must be optimally fixed to refined pulp components and the respective fibre fractions must be retained in the paper.

**Objective/Research results**
The project work aims to ensure the optimum performance of functional additives in wood-free graphic papers, specialty and sanitary papers, in order to achieve the desired paper properties with minimum additive dosages. For this purpose, their mechanisms of interaction — especially when using several additives simultaneously — must be clarified to avoid competing reactions. Pulp-additive combinations will be improved, taking into account pulp freeness, and dosing points and dosing sequences will be optimised.

Initial studies have been performed with model systems in the laboratory to clarify the basic course of reactions and distribution characteristics of the additives. What has yet to be investigated is how additives fixed to fines contribute to the development of paper properties. Practical applications of the findings in full-scale processes as well as consulting projects in paper mills have shown that the numerous additives used in papermaking do interact with each other and that their interactions impair or — in the case of simplex or displacement reactions — even prevent their fixation on fibres.

Additives must be fixed to (refined) fibres and retained in the paper.

**Basic mechanisms of interaction are:**
- Strong electrostatic interactions between cations and anions (cationic additives, anionic pulp components, simplex formation between cationic and anionic additives)
- Substantive interactions, interactions with the dipoles of hydroxyl groups of extended cellulose molecules present on fibre surfaces, formation of charge-transfer complexes (e.g. CMC, direct dyes, optical brighteners, hemicelluloses)
- Formation of covalent bonds between the hydroxyl groups of fibres and reactive groups of additives (e.g. wet strength agents, AKD- and ASA sizes, formation of ethers or esters)

Initial small-scale papermaking tests were performed in the PTS pilot plant, using different functional additives and varying their reaction times in the range of 30 s and 360 s. Prolonged reaction times of retention aids, WSA and AKD were found to produce no changes in strength and optical properties of paper, whereas brightness levels were found to increase and tensile indices decreased the longer the reaction time of optical brighteners.

**Application/Economic benefits**
The main economic effect of the project is savings in additive costs (up to approx. 15 % of the additives used), in pulp costs due to more cost-effective alternatives (savings up to approx. 50 €/t) and in production costs due to fewer standstills.

Additional revenue may be earned from more consistent product quality and the avoidance of broke (up to approx. 20 €/t) as well as from the development of new, high-quality and innovative paper products in the specialty paper segment (100 – 200 €/t by product substitutions).

**Project period:** 01.04.2006 – 31.03.2008

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