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Research area: Product aims
Paper, paper board and board // Graphic papers

Key words:
Gloss, nano particles, calendering

Title: Reducing calendering conditions via targeted use of nano particles

Background/Problem area

Paper surface properties may be even more important in Germany than elsewhere, due to the high amount of coated paper produced here. Enterprises supplying colour components or machinery, providing services in assembling, maintenance etc. are closely related to paper manufacturers, as well as print shops and publishers.

Gloss is an important property of printing papers. Calendering, the most effective means to improve paper gloss, shows disadvantageous effects on other paper properties like bulk, stiffness etc. Coated paper gloss can be improved by using plately and glossy pigments, increasing coat weight, increasing the solids content of the coating colour, and other appropriate components. Levelling the surface with a blade (bent blade) is advantageous for high gloss.

Elastic forces of the coating colour and shrinking forces derived from the binder are most important for gloss reduction during coating colour consolidation if the theory is valid that pigments are more or less ideally adjusted parallel to the paper base. The project is directed to minimize the effects of these forces.

Objectives/Research results

The objective of this project was to investigate in how far the calendering conditions can be reduced when the coating colour composition is changed. First insight is given by using identical calendaring conditions and and determining the gloss development of different samples. The changes in coating colour were based on the above explained idea of pigment movement due to the shrinkage of the binder during drying.

Experiments in lab scale indicated especially the need for pilot trials as it was sometimes hard to differentiate the results with varied material. Therefore, a significant number of pilot trials was conducted using the same paper base and testing different variations from a coating colour formulation for rotogravure and for offset printing, respectively, att the same coat weight.

Pigment shape proved to be dominating for gloss development, as expected. Therefore, coating colour based on platy clay pigments (rotogravure), and offset formulations based on CaCO3 – clay blends, coarse or steep CaCO3 served as references. The effects of comparatively small amounts of different nano-sized particles and other organic additives were investigated

The storage modulus of a coating colour correlates very well with the gloss of coated paper, as long as the pigment base is unchanged. This was found very obvious for carbonate-based coating colours, but seems to be true for pigment blends with platy pigments as well.

Nano-sized particles in coating colours can have different effects, depending on their dispersion and on the particle size distribution of the pigment base of the coating colour they are added. Narrow-sized CaCO3 particles blended with nano-sized particles of different origin lead to a significantly better gloss development of coated paper. In some cases, however, gloss was reduced by the nano-particles, probably due to non-uniform dispersion.

The complete evaluation of the experimental results, including different calendaring positions, will be put together in the final report.

Application/Economic benefits

New ways for gloss improvement have been demonstrated. Manufacturers of coated papers, packages and chemical additives can broaden their product portfolio with the application of such ways.

Economic benefits can be obtained when the change of polymer-based additives (like thickeners) of similar costs is used for a gloss improvement.

Economic benefits from nano-sized particles in coating colours can especially be obtained if the costs for these materials decrease in the future. Additionally, care has to be taken that such particles are bound properly in order to avoid safety risks when primary nano particles are set free.

The research results can be used for material sciences, especially in paper engineering.

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Remarks

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