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Research area: Product aims

Paper, paperboard and board // Packaging papers and paperboard

Key words:

Coating, barrier properties, mineral oil, hydrocarbons, phthalates, benzophenone, inorganic pigments, migration, tortuosity

TITLE:

Improving the performance of barrier coatings against low molecular organic trace components by the effective use of inorganic pigments and suitable binders

Background/Problem area

Secondary fibre paper and paperboard for food packaging contain traces of low molecular organic substances that are introduced primarily via the printing inks, varnishes, adhesives and chemical additives. Some of these substances can migrate directly or indirectly into the foodstuffs via gas phase transfer. The public notice of impurity traces originating from recovered pulps is mainly driven by NGO reports and - as follow up- by customer demands towards paper manufacturers and converters. Irrespective of legal regulations, the German paper industry has a great interest in reducing health risks to consumers. Papers for recycling, however, are an essential raw material for the production of food packaging paper and board. In Germany of the approx. 9 million tonnes of packaging made from paper, paperboard and board, approx. 2.3 million tonnes of food packaging are made based on paper for recycling. It would be fatal both economically and ecologically in particular for smaller papermaking and paper converting plants if this source of raw materials could no longer be used for food packaging.

Objectives/Research results

The project objective is to prevent the migration of low molecular organic substances via the gas phase by means of efficient, pigment-containing coatings, and in this way contributes to the protection of the paper recycling loop. The substances that migrate via the gas phase and may eventually include a potential risk include mineral oil hydrocarbons as well as phthalate plasticisers and benzophenone. These substances are within the focus of this project. Up to now, pigment-containing coatings have been studied as to their capability to reduce mineral oil migration in isolated cases only. Relevant possibilities for reducing phthalate and benzophenone migration, however, have not been published so far. An additional objective of the project is to improve migration test methods for barrier coated paper sample in such a way that prediction of long term migration will be possible.

At the beginning of the project the base components for the barrier coatings are selected. The selected pigments contain mainly different types of kaolin, talcum, bentonites, preciptated calcium carbonates and some unusual types like illite, mica and montmorillonite. The polymeric part contains acrylates, acrylate-copolymers, PVOH, PVOH-copolymers vinylacetate-copolymers, hydroxyethyl-cellulose and methylhydroxypropyl-cellulose. Formulations are made and applied on laboratory scale in constant amounts on a base paper (machine finished craft paper).

The results of the trails show very low migration through layers of PVOH, PVOH-copolymers vinylacetate-copolymers, hydroxyethyl-cellulose and methylhydroxypropyl-cellulose. These products are suitable for building up barrier layers against mineral oil hydrocarbons, phthalate plasticisers and benzophenone. By addition of laminar pigments migration decreases further. Best results are obtained with combinations of PVOH, PVOH-copolymers, hydroxyethyl-cellulose, methylhydroxypropyl-cellulose with kaolin and bentonites. In this cases scanning electron microscopy (SEM) reveal a high orientation of laminar pigment particles. The tortuosity effect often predicted in literature is mainly verified within these investigations.

Time and temperature dependent migration experiments show that for extrapolation to long storage times the use of time dependent data will be better than the use of temperature dependent migration data. Higher temperature (60°C and more) may cause more and sometimes unexpected deviations.

Results are mainly verified with the system kaolin / hydroxyethyl-cellulose on a fast running pilot coater using the reverse side of a whitelined chipboard as substrate.

Application/Economic benefits

The use of pigments in barrier coatings is intended to save polymeric coating agents, thus cutting costs. Assuming the polymeric coating agent costs 4 €/kg (dry) and 20 % of it is replaced by a pigment (approx. 0.4 €/kg) in the coating, the result will be a cost savings of 18 % in the starting materials due to the volume effect alone. If the thickness of the coating can then be reduced by one-third due to the tortuosity effect, this would add up to a cost savings of approx. 50 %. Against the background of growing statutory regulations that also include the application of barrier coatings, a competitive edge will be achieved in future for the sectors affected.

Period of time: 01.04.2015 – 31.05.2017

Remarks

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