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Research area: Process aims

Paper and paperboard production // Surface treatment

Key words:

Curtain coating, multi layer, transport, drying

TITLE:

Simultaneous wet on wet coating utilizing multi layer curtain coating for manufacturing coated cardboard packaging, especially taking into account the transport processes of coating colour ingredients during drying of the coating

Background/Problem area

Folded cardboard boxes offer manifold possibilities concerning the design on the packaging surface and therefore claim a considerable share of the packaging market. Each layer of the coating on the cardboard possesses defined properties which in combination are responsible for the quality of the product. Commonly, these different layers are applied by repeated single layer coating techniques such as blade coating. In recent years simultaneous multi layer curtain coating has become a cost reducing alternative, since only one multi layer coating pass is necessary.

However, it can be expected that there are significant differences in penetration or transport of coating colour ingredients, especially during the drying process, when comparing multiple pass single layer coating (wet on dry) with one pass multi layer curtain coating (wet on wet). Such differences in mobility of coating colour ingredients could have a significant effect on the desired function of the different coating layers, thus having an influence on the properties of the final coated cardboard product.

Objectives/Research results

The aim of this project was to elucidate the amount of potential lateral transport of coating colour ingredients in multi layer curtain coating, especially depending on the drying parameters. In comparison with single pass coating the influence of such potential mixing of different layers on the performance of the resulting multi layer structure was investigated. Regarding drying parameters, especially the type of drying (convective or irradiative) was varied.

As a first step, two layers were applied with a bar coater on top of one another. The first layer contained methyl blue, a water soluble colouring agent. Through comparison of applying the layers wet on wet and wet on dry with subsequent measuring of the colour intensity on the top layer, an indication of how far the colour had penetrated could be expected. Unfortunately the measurements did not yield the expected result – the wet-on-dry samples revealed a more intense blue than the wet-on-wet samples. An explanation could be the shining through of the concentrated blue in the wet on dry case, whilst in the wet on wet samples the more blurred interface led to a less strong shining through of the blue colour.

The next step involved coating on the Laboratory Curtain Coater. The main goal was to obtain images of cross sections which would show if the Ti in the top layer would penetrate into the bottom layer. Therefore SEM-EDX (Energy Dispersive X-Ray) analyses of coat layer cross sections were taken. Fine titanium dioxide particles were used in the top coat (20 parts related to overall pigment shares). After achieving the proper rheology for the coating colours, the coatings were applied by multilayer coating as well as by single coating steps using the curtain coater with intermediate drying. Compared to the coating with intermediate drying, the multilayer coating process produces a slightly less clear-cut interface. Regarding particles of this size, however, the integrity of layers was largely maintained. As a possible advantage, the slight mixing (blurred interface) was likely to improve the adherence between adjacent layers.

Also regarding the investigation of cross section with TOF-SIMS no significant migration of the detected binder (nitrile-detection) was observed. Both the in SLCC and MLCC samples revealed that the binder remained in the layer it was applied in. In the samples where the detectable binder was applied in the precoat on the base paper, a slight penetration of approx. 10% of the binder into the base paper was be observed. In summary no unwanted negative differences in quality between MLCC and conventional rod/blade application technique due to migration phenomena were observed.

Application/Economic benefits

The results of this project are mainly of interest for the industrial sectors paper, publishing and printing. Furthermore, also branches of chemical industry as well as mechanical engineering may profit from this research project.

The most obvious benefit would be cost reduction due to reduced counts of machine passes. Use of multi layer curtain coating in a single machine pass instead of multiple single pass blade coating, whilst achieving the same or even better quality would result in a significant cost advantage. Additionally the transition from blade coating to curtain coating leads to a more uniform surface resulting in better printability for certain products.

More specifically, the following industries may profit for the following reasons. Cardboard and paper manufacturers would profit because of higher capacity and reduced average costs per unit. Paper converters and printers would benefit by receiving better quality combined with less complaints necessary to the supplier and less complaints from the customer of the final product. Finally, also smaller and more specialized coating chemistry producers may gain access to new markets in the area of chemical additives for curtain coating.

Project period: 01.05.2009 – 30.04.2011

Remarks

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