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Research area: Process aims
Paper and paperboard production // Surface treatment

Key words:
Optimization of curtain-quality, online-monitoring system, quantitative evaluation of curtain-stability, curtain-defects

Title: Improving efficiency and quality of curtain coating via online monitoring

Background/Problem area

In most cases paper and paperboard is coated to enhance its surface characteristics. Curtain coating is a non-impact coating technology where the coating colour drops like a curtain onto the paper from a slot in the applicator unit. Due to its excellent coverage at reduced coat weights, curtain coating can offer significant economic and process advantages.

However, in high speed curtain coating, there are unresolved questions that prevent the paper industry from commercially accepting the technology for producing graphic paper and board. Generally speaking, the performance of the coating process is determined via the quality of the end product, i.e. the coated paper. However, there is not much information available about how the curtain determines this quality. It is commonly agreed that a stable curtain is necessary for a good curtain coating process but there is a lack of any definition for curtain stability or, more generally, for curtain quality, although detailed knowledge about the various influences and interactions is a precondition for achieving high product quality.

Objectives/Research results

It is understood that the curtain coating process greatly determines product quality. There are various characteristics of the curtain itself that cause this impact. For instance, even tiny bubbles in a curtain or inhomogeneities of a curtain, induced by coating colour deposits in the vent of the coating head, can cause coating defects. Furthermore, the waviness and deflection of a curtain will affect the quality of the coated paper when coat weight falls below a specific limit. Regardless of the fact that curtain thickness is not a quality parameter in terms of a good vs. bad classification, it is yet another essential curtain parameter that has to be within a specific range.

This research project was aimed at detecting and measuring these characteristics and the shape of a curtain, and at correlating these quantities with the effects of the coating. Thus, we needed to employ a suitable sensor system that is able to capture the curtain parameters mentioned above. Since there are no commercial systems that fulfil these specific tasks, we initially developed our own online monitoring system to examines the curtain. This included both designing the respective measurement setup and selecting suitable hardware. Furthermore, we designed and implemented the corresponding algorithms that evaluate the sensor outputs.

The algorithm results supported the derivation of effects on curtain stability and on the colour coating caused by the parameters considered. In general, it turned out on the one hand that we were able to capture the curtain behaviour in great detail, i.e. we could measure variabilities in parameter values even if they were marginal and did not influence coating. It follows from this of course that we were also able to observe the much more interesting range of values that influences product quality. For instance, we could show a good quantitative correlation between curtain inhomogeneities and corresponding coating inhomogeneities. Similar coherences could also be derived for waviness and deflection, respectively. Due to design limitations, on the other hand, it was impossible to detect air bubbles below the size of approx. 25 µm. This was unfortunate since even bubbles below this size can cause coating defects. Nevertheless, detection of such bubbles is not a ‘structural’ problem but rather a technical challenge.

In summary, we developed an online monitoring system that quantitatively captures relevant curtain parameters and were able to verify the influences of these quantities on paper quality. In other words, we laid down the basis for controlling curtain quality at a higher level of granularity.

Application/Economic benefits

The description of those curtain parameters that are reasonably manipulable together with publication of the algorithms that detect and measure various curtain parameters provide a valuable basis for enhancements or redevelopment of measuring technology. The solutions suggested can be applied both in production lines and pilot facilities. Moreover, the models that relate curtain quality with coated paper quality as well as the corresponding control factors can influence the design of completely new controlling algorithms for curtain coaters. This increases the competitive capacity of the system and machine manufacturers as well as providers of measuring and control technology.

A further advantage arises for the users of curtain technology. Since the precise knowledge about the quality determining parameters allows optimal curtain stability to be adjusted, there will be constant quality and less susceptibility to failure. This improvement in the coating process will lower production costs.

For manufacturers of coating colour and additives, curtain quality measurement provides a valuable tool in the context of product testing. These tests can be carried out on any pilot coater that is equipped with the developed monitoring system. The effects of coating colour modifications can be reproducibly captured by means of the curtain parameter values. This improves the expressiveness of each single test run. Hence, complex test runs can be shortened and this can result in a faster commercial launch of both new or modified products.

Project period: 01.06.2008 – 31.08.2010

Remarks

Research project IGF 15672 BG is being funded by the German Federal Ministry of Economics and Technology BMWi.