NEW ADVANCES

Tech Talk

in paper coating technology

A new patented nozzle for curtain coaters allows precise sectional volumetric correction of flows to ensure even coating across the entire web surface. Another advancement makes it possible to apply barrier layers in the inboard mode without defects at the edges.

NEW NOZZLE FOR MULTI-LAYER COATING

Curtain coating transfers a thin film of falling liquid (the "curtain") from the applicator die to a moving web of paper or board. When applying multiple layers simultaneously, the thickness and composition of each layer must be constant over the entire web surface. Achieving this can be particularly difficult with wide webs and/or a wide range of coating weights.

Certain packaging materials require environmentally friendly and sustainable barrier layers to prevent the migration of oxygen and/or oils. ANDRITZ developed a new type of nozzle for these multi-layer barrier applications which has advanced cross-direction (CD) profiling. For the first time, it is possible to make volumetric corrections to the CD profile of inner layers and produce a completely uniform coating without defects.

THE LABYRINTH BREAKTHROUGH

In collaboration with research institutes, ANDRITZ tested different variations of diffuser block and nozzle geometries. In 2013, there was a breakthrough. A new type of diffuser block was produced with a labyrinth geometry. Extensive CFD studies were conducted to optimize the shape of the labyrinth. This led to a nozzle outlet geometry that achieved the most even coating distribution possible.

Numerous tests were conducted on a prototype unit to confirm the CFD simulations. Figure 1 shows the prototype with eight diffusers in the block and a labyrinth with three expansion chambers. Extensive tests confirmed that the labyrinth renders the flow absolutely evenly.

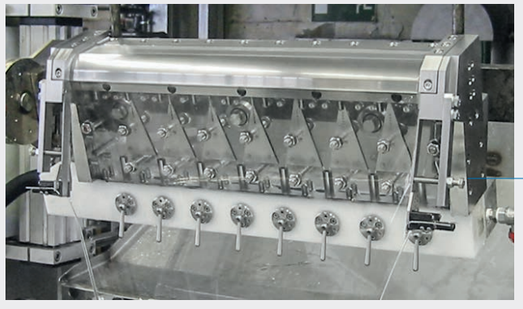


Figure 1. Prototype of new nozzle with sectional volumetric correction of the CD profile.

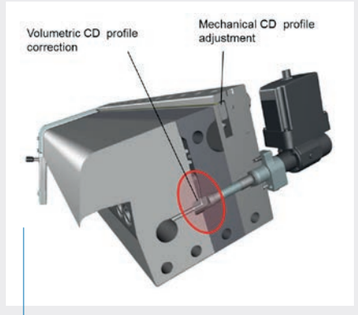
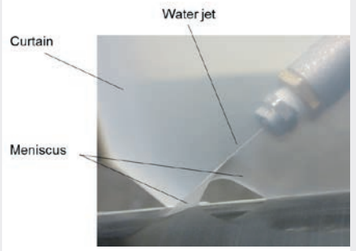


Figure 2. Cascade nozzle with sectional volumetric correction and mechanical CD profile adjustment combined.

The design combines volumetric correction and mechanical cross-profiling to create a cascade nozzle that can simultaneously apply a thin barrier layer and a top coat of desired thickness in a stable curtain that can be adjusted online during production.

The CD profile of the first layer (which is usually the most expensive material) is controlled by specialized valves that adjust the flow volume zone-by-zone across the web. This is done on-the-fly without interrupting production. The top layer of coating, which normally has a constant thickness and solids content, is easily set with the mechanical cross-profiling adjustment.

Figure 3. Operating principle of the new ANDRITZ edge guide system.



Conventional edge guide systems	Comments
Overboard	Coating on rear side Color deposits on guide rolls Coating with barrier not possible in many cases Not cost-effective
Inboard with color removal by suction	Color deposits on return run Not capable of continuous stable production
Inboard with one overflow and one mechanical cutting element	Edge beading (edge too thick) Color deposits on guide rolls during drying Not capable of continuous stable production
Inboard with one overflow and cutting of the curtain in a conventional water jet process	Edge beading Not capable of continuous stable production

Table 1. Limitations of conventional edge guide systems for barrier coatings.

EDGE GUIDE SYSTEM FOR INBOARD BARRIER COATING

The challenges of inboard coating (i.e., coating within the width of the web) center around variations in the coating at the edge of the web, and the potential damage to the uncoated portion of the paper/board substrate. Conventional edge guide systems such as simple guides or edge guides with lubrication layers all have limitations (Table 1). None of these existing systems are able to completely fulfill the requirements for challenging inboard barrier coat applications.

ANDRITZ developed a new edge guide system that uses advanced water jet technology. This makes it possible for the first time to apply barrier layers in inboard mode without coating defects at the edges. It can be used with a wide range of coatings – from very thin to very thick barrier layers – and it can operate continuously without downtime for cleaning.

Due to the buildup of coating on conventional edge guide devices, production lines can typically be operated only in short intervals before cleaning is required. With this new system, the nozzle can be operated continuously since deposits on the equipment are eliminated by the water jet.

Figure 3 shows the operating principle of the new edge guide system. A water jet nozzle is mounted between the coating curtain and moving paper web. The angle between the jet and the curtain is critical.

Unlike conventional water jet systems where the curtain is cut by the kinetic energy of the jet, this new system stretches the curtain before gently cutting it. The curtain becomes thinner and thinner along the length of the water jet until its thickness falls below the minimum, at which time it is cut. In this way, the coating color on the inside is spread over a larger area. Since there is only a small amount of color at the edges, no significant beading occurs. Eliminating beading by stretching the inner side of the curtain avoids contamination and discourages layers from sticking together on the roll.

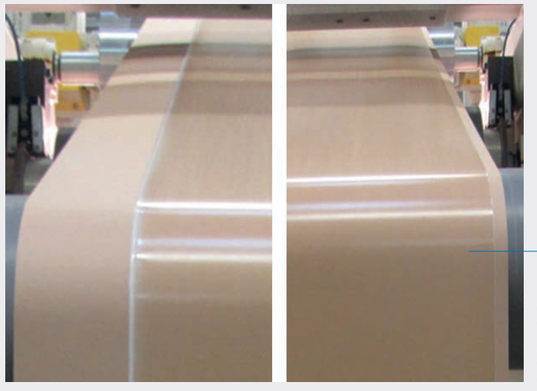


Figure 4. Comparison immediately after coating: with conventional mechanical system (left) and with ANDRITZ edge guide system (right).

EXTENSIVE TESTING

Numerous pilot tests with different barrier colors and viscosities confirm the performance of this new edge guide system. The system is robust in handling these changes and no adjustments were required in the setup of the water jet for the different coatings.

The low water pressure required to stretch and cut the curtain makes the design simple, economical, and safe to operate. The jet nozzle is positioned so that the water is carried off alongside the paper web, minimizing the space required between the cutting point and the paper web. With a stable cutting edge, it is possible to minimize edge trim losses.

Figure 4 shows the web immediately after coating. While edge beading is apparent with the web treated using a conventional mechanical device (left photo), the web from the new edge guide system has no edge defects (right photo).

CONTACT
Dr. Eduard Davydenko
dr.eduard.davydenko@andritz.com