

Curtain Coating for Functional Paper and Packaging Applications

The demands placed on coated paper and board products continue to increase. Today's markets require highly functional surfaces, excellent coating uniformity, cost-efficient production, and environmentally responsible manufacturing. Whether the target application is inkjet media, thermal paper, release liners, barrier packaging, or other specialty grades, the coating process plays a decisive role in determining product performance.

Curtain coating offers a unique combination of precision, flexibility and production efficiency. While the technology originated in the photographic industry, where it became the established standard for manufacturing single- and multilayer products, it has steadily expanded into paper and board applications requiring highly controlled coating structures.

Today, curtain coating is increasingly recognised as a viable technology not only for specialty papers but also for advanced packaging materials and functional fibre-based products requiring precise multilayer architectures.

A Premetered Technology with Distinct Advantages

Curtain coating belongs to the family of premetered coating methods. Unlike conventional metering systems that apply excess coating and subsequently remove the surplus, curtain coating deposits exactly the amount of coating liquid required to achieve the desired coat weight. As a result, coat weight can be accurately predicted through mass conservation principles and remains largely independent of coating rheology or application geometry.

The technology offers several significant advantages:

- Simple and accurate coat weight control
- Excellent machine-direction and cross-direction coating profiles
- Contact-free application
- No excess coating colour circulation
- Fast product changeovers
- Minimal mechanical wear
- Reduced coating defects
- Simultaneous multilayer coating in a single pass
- Potential for two-component and functional coating systems

Because the coating curtain does not mechanically contact the substrate, common defects associated with blade or roll coating systems, such as streaks, scratches, splashing, or orange-peel effects, are virtually eliminated. This contour coating characteristic also allows uniform coverage on substrates with varying surface topography.

Operating Window and Process Considerations

Like every coating technology, curtain coating operates within a defined process window. Key parameters include viscosity, surface tension, coating thickness, web speed, and flow rate.

Industrial experience has demonstrated operating speeds exceeding 2,000 m/min while maintaining excellent coating quality. Typical application ranges include viscosities from approximately 0.01 to 10 Pas and the capability to apply multiple simultaneous layers, often exceeding ten layers when required.

A particularly important parameter is the specific flow rate required to maintain a stable curtain. While thick layers can readily be applied at low speeds, very thin coatings may require higher operating speeds to ensure curtain stability. Multilayer technology provides an elegant solution by combining several functional layers into a single stable curtain structure.

Multilayer Coating: The Real Strength of Curtain Technology

The ability to apply multiple wet layers simultaneously remains one of the defining advantages of curtain coating. Modern slide-die systems allow individual coating liquids to be combined moments before application while maintaining clear layer separation. Each layer can be engineered to perform a specific function within the overall coating structure.

In a multilayer slide die, individual coating liquids exit separate metering slots and flow together down a cascade surface before forming the coating curtain. This design allows:

- Very thin functional layers
- Combinations of different coating chemistries
- Improved process stability
- Reduced drying requirements
- Enhanced product functionality
- Optimised raw material usage

It is also possible to divide a single thick layer into several thinner layers, improving curtain stability while maintaining the required final coating structure.

Applications in Functional Paper Production

Inkjet Papers

High-quality inkjet papers are among the most successful examples of multilayer curtain coating technology. Typically, these products consist of:

- A thin primer layer to improve adhesion to the paper substrate
- A thick absorption layer to control ink uptake
- A thin topcoat providing gloss, protection and surface performance

Conventional coating systems often require multiple coating and drying stages to create such structures. Curtain coating enables all functional layers to be applied simultaneously in a single pass, reducing process complexity, energy consumption and production costs.

Thermal Papers

Thermal papers are another established application. These products generally require a barrier layer applied directly onto the substrate, followed by a thermally sensitive layer and a protective topcoat. Accurate control of individual layer thicknesses is essential for product performance and durability. Curtain coating delivers the required precision while simplifying production.

Adhesives and Functional Structures

Examples from the adhesive industry demonstrate further potential for paper applications. A thick adhesive layer can be separated into a thin functional layer providing high adhesion and a thicker layer primarily responsible for achieving the required coat weight. This allows expensive functional materials to be used more efficiently while maintaining overall product performance.

New Opportunities in Packaging

As the packaging industry increasingly shifts towards fibre-based alternatives and functional barrier papers, curtain coating is attracting renewed attention. Barrier coatings, sealing layers, oxygen barriers, grease-resistant coatings and other functional surface treatments often benefit from multilayer architectures that can be created efficiently using curtain technology.

The ability to accurately position functional materials exactly where they are needed helps reduce raw material consumption while maintaining performance. Combined with the elimination of excess coating circulation and the possibility of reducing drying requirements, this supports both sustainability and manufacturing efficiency.

Modern Die Technology Expands Possibilities

Advances in die manufacturing and fluid distribution technology have significantly broadened the industrial applicability of curtain coating. Production dies with working widths exceeding 4.5 metres are operating successfully in industrial environments, while fully automated coating-width adjustment systems provide additional flexibility for specialty paper production.

These developments have transformed curtain coating from a niche process into a mature production technology capable of supporting demanding industrial applications.

Conclusion

Curtain coating has developed into a highly sophisticated coating technology capable of meeting the growing demands of modern paper and packaging markets. Its combination of precise coat weight control, excellent coating uniformity, contact-free operation and multilayer capability makes it particularly attractive for functional products.

What initially became the technology of choice for photographic products has evolved into a versatile platform for specialty papers, thermal papers, inkjet media, release products, barrier-coated substrates and advanced packaging materials. As manufacturers continue to pursue improved product functionality, higher efficiency and more sustainable production processes, curtain coating offers a compelling solution with substantial untapped potential for future paper and board applications.