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EVOLUTION OF GRAVURE COATING TECHNOLOGY: FROM OVERFLOW CHAMBERS TO PRESSURIZED RAVURE SYSTEMS AND THEIR POSITION VERSUS CURTAIN COATING

ABSTRACT
Gravure coating has long been a cornerstone technology for high-speed, roll-to-roll functional coating processes. Increasing demands for cost efficiency, sustainability, and coating precision are now driving a shift beyond conventional system designs. This paper compares two gravure chamber concepts—the traditional overflow system and the advanced Pressurized Gravure System (PGS®)—and positions them relative to curtain coating as a high-performance alternative.

The conventional overflow gravure system is characterized by significant recirculation flows, often exceeding 200% of the applied coating volume. While robust and widely used, this approach introduces inefficiencies, including high material inventory, foaming risks, additional capital expenditure for tanks and pumping infrastructure, and increased operating costs due to coat weight variations that must be compensated by higher application levels.

In contrast, the Pressurized Gravure System (PGS®) represents a shift toward near pre metered coating. With minimal return flow (typically <5%), it enables a “coat-what-you pump” principle. This reduces material circulation, eliminates foam formation from recirculation, and minimizes the need for external tanks and complex piping. As a result, both capital expenditure and operational losses are significantly reduced, while coating uniformity approaches that of slot-die or curtain coating.

Beyond efficiency gains, PGS® offers high process flexibility. Its broad coating window and tolerance to formulation variations enable use across diverse applications, including emerging energy technologies. In battery manufacturing, separator and electrode primer coatings serve as examples of applications enabled by the method’s high reproducibility with sensitive, high-value materials.

Curtain coating remains the benchmark for multilayer precision and long-run efficiency in stable, high-volume production. Its wet-on-wet capability enables advanced layer architectures, such as cost-optimized adhesive systems combining functional outer layers with filler-rich core layers. However, these advantages come with high capital requirements, narrow operating windows, and limited adaptability.

Overall, while curtain coating excels in standardized large-scale applications, PGS® bridges the gap between flexibility and precision. It extends gravure coating into areas traditionally dominated by pre-metered systems, offering a strong balance of cost efficiency, process stability, and versatility.