Curtain Coating Slide Die Technology: What you need to know.

Presented By:
Bob Shakal
Business Development Director
Fluid Coating Dies
Overview

- Contact Wipe Coating
- Non-Contact Draw Coating
- Curtain Coating
Curtain Coating Dies

Flow/Die angle can be between 15 and 75 degrees. Die angle impacts the fluid velocity on the slide surface.

Single layer coatings can be applied with a die located in the inverted position.
# Coating Technology Comparison

<table>
<thead>
<tr>
<th>Technology</th>
<th>Typical Min Visc</th>
<th>Typical Max Visc</th>
<th>Typical Line Speed Min</th>
<th>Typical Line Speed Max</th>
<th>Typical Wet Ct Thick Min</th>
<th>Typical Wet Ct Thick Max</th>
<th>Typical Coating Uniformity</th>
<th>Layers</th>
<th>Patch Coat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Contact Draw - Slot Die Coating</td>
<td>1 cps</td>
<td>250 Kcps</td>
<td>0.15 mpm</td>
<td>600 mpm</td>
<td>&lt;10µm</td>
<td>3810 µm (0.150”)</td>
<td>1-2%</td>
<td>3</td>
<td>Yes</td>
</tr>
<tr>
<td>Curtain Coating</td>
<td>1 cps</td>
<td>~3000 cps</td>
<td>120 mpm</td>
<td>2500+ mpm</td>
<td>&lt;5µm</td>
<td>500µm (0.020”)</td>
<td>&lt;1%</td>
<td>Unlimited</td>
<td>No</td>
</tr>
</tbody>
</table>
Discussion Topics

- Key Markets/Applications/Benefits
- Critical die design considerations
- Capabilities
- What drives you to using this technology…”The advantages and potential benefits”
- Things to consider when moving to Curtain Coating Technology
Market Share Trend by Technology

Technology Shift Drivers

- Increased line speeds
- Thinner coatings
- Cross web uniformity
- Fluid savings and consistency
- Reduced equipment costs – one die vs multiple rolls
- Reduce waste (Fluid & Substrate)
- Less contamination
- Reduced maintenance
- Environment (Reduced VOCs) closed systems
- Move towards reactive chemistries


Market Share by Technology

TAM $235M $300M CAGR 4%

SAM $105M $155M CAGR 6.5%

2017 2020

Other Blade
Knife over roll Multi-layer cascade
Roll Coaters
Mayer Rod Gravure Coating
Curtain Multi-layer Slot Die
Slot Die

## Slide Curtain Coating Dies – Markets

<table>
<thead>
<tr>
<th>Markets/Industries</th>
<th>Advantage of Curtain Coating Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Label Industry</strong></td>
<td>Higher speed, multiple functional layer, better uniformity, elimination of streaking on “clear on clear”</td>
</tr>
<tr>
<td><strong>Photographic Industry</strong></td>
<td>Multiple functional layers, elimination of streaking</td>
</tr>
<tr>
<td><strong>Paper Industry</strong></td>
<td>Higher speed, better uniformity, lower coat weight, reduced energy costs because of thinner coatings</td>
</tr>
<tr>
<td><strong>Cardboard Packaging Materials</strong></td>
<td>Multiple functional layers, different properties, better uniformity</td>
</tr>
<tr>
<td><strong>Furniture Industry</strong></td>
<td>High gloss application, multiple functional layers, excellent uniformity</td>
</tr>
<tr>
<td><strong>Optical (Glass) Panel Coating</strong></td>
<td>High Speed, uniformity, very thin coatings (can be sub-micron)</td>
</tr>
</tbody>
</table>
Slide Curtain Coating Dies - Benefits

• Higher Line Speeds
• Excellent cross-web uniformity and lower coat weights
• Non-Contact application process means no streaking defects
• Can be used on smooth, rough or contoured surfaces
• Fewer Web Breaks
• Short Cleaning Time
• Low Maintenance
• Reduced waste.
• Practically unlimited multilayer capability, let your process/product engineers go crazy!
Curtain Coating Terminology

- Lifting Eye Bolt Structure
- Multi-Layer Slide Curtain Die
- Possible Additional Layer
- Die Angle
- Side Plate
- Edge Guides
- Curtain
- Backing Roll
- Die Support/Cradle
- Die and machine support interface
- Side Plate
Fluid chemistries are critical in the ability to create a fluid curtain.

The specific flow rate is important to achieve a stable process and to produce a minimum coat weight at a given web speed.

Curtain stability is extremely important and crucial for low coat weights at all line speeds.

Curtain coating creates an even coating even on uneven surfaces.

It is possible to split one big layer into multiple layers to improve the entire process.
Slide Curtain Coating Dies

2 Layer Curtain Die with End Plates and Edge Guides assembled
Slide Curtain Coating Dies

Single Layer Fluid Curtain Formed in the “Off-Coat” Position
Slide Curtain Coating Dies

Uniform & Stable curtain
Slide Curtain Coating Dies – Critical Characteristics

Curtain Impingement Zone

- Excessive Heels
  - Create the potential for interlayer mixing.
- Air Entrainment
- Wandering/Varying Dynamic Wetting Line.

Edge guides are used to keep the fluid at the proper coating width.
Curtain Coating Components

Slide Curtain Die
- Manifold design
- Slot gap tolerance
- Lip Inserts (if required)

Edge-Guide
- Length
- Water rinsing ports
- Vacuum Port

Fluid Delivery System
- Viscosity
- Solid Content
- Bubble-free
- Pulse-free

Web-Flow/Speed
- Web-wind
- Constant speed
- Pulse-free

Die Angle
Die is most of the time 15 - 75 degrees from vertical for all applications and viscosities
## Slide Curtain Coating Dies – Capabilities

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Premier Fixed Lip Slide Curtain Coating Die</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lip Gap Adjustment</td>
<td>Fixed</td>
</tr>
<tr>
<td>Gap Accuracy</td>
<td>A ±1.25 µm, AA ±0.95 µm, AAA ±0.635 µm</td>
</tr>
<tr>
<td>Coating Thickness (wet)</td>
<td>Usually Greater Than 1 µm (Wet)</td>
</tr>
<tr>
<td>Coating Weight Accuracy</td>
<td>Usually ± 1% or Less Cross Web</td>
</tr>
<tr>
<td>Coating Principle</td>
<td>Non-Contact</td>
</tr>
<tr>
<td>Coating Speeds</td>
<td>Usually 60 – 2500+ MPM</td>
</tr>
<tr>
<td>Max. Coating Width</td>
<td>Depends on What the Customer Needs 😊</td>
</tr>
<tr>
<td>Number of Layers</td>
<td>Unlimited</td>
</tr>
<tr>
<td>max. Operating Temperature</td>
<td>max. 80°C</td>
</tr>
<tr>
<td>Viscosity Range</td>
<td>1 to 3000 cps (typical)</td>
</tr>
</tbody>
</table>
Slide Curtain Coating Dies – Things to Consider

Things to think about when deciding to use slide curtain die technology

- Consult your fluid suppliers to see if your fluid(s) have the necessary chemistry to create a stable curtain.
- Production and machine speeds meet or are above the specific flow rate
- Production drying capacity meets needs at the higher line speeds and coat weights
- Potential to increase the solid content
- Single or multiple functional layer application always considering the drying capabilities
- High performance and high accuracy application requirements
Slide Curtain Coating Dies – Advantages

Feedback from Technology Users

By using Slide Curtain Die Technology customers have:

- Increased machine speed due to thinner coatings and higher solid content
- Reduced the price per square meter due to efficiency improvement
- Less wear parts and less down time due to technology shift
- Higher quality output due to non-contact application mode
- Material savings due to improved uniformity level
If anyone is interested in doing curtain coating trials see me at our table and I can give you information on who to contact.
Thank you for your attention!

Questions?