Pattern Coating by Slot-Die

SCOTT A. ZWIERLEIN
FRONTIER INDUSTRIAL TECHNOLOGY, INC.
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Program:

• Slot-Die Coating Overview
• Industries for slot-die coating
• Stripe coating
• Requirements for good stripe coating
• Description of patch coating process
• Requirements for good patch coating
• Remarks and questions
Roll to roll slot die coating is becoming the industry standard for extremely thin and extremely accurate liquid film coatings. The attainable thickness accuracy for coating using a slot die is \( \sim 1-3\% \)
Attributes that lead to this type of coating accuracy are:

- Precision Pre-metered Fluid delivery
- Extremely flat and straight die surfaces
- High precision backing roll
- Accurate and precise positioning of die to the substrate
- Vacuum box assembly for coating bead stabilization
Areas of industry where slot die is becoming increasingly necessary:

- Micro-electronics
- Batteries and Capacitors
- Barrier films
- Solar photovoltaic
- Fuel cells
- Medical diagnostics
- Transdermal and oral pharmaceuticals
Stripe Coating:

Some finished products are narrow strips and slitting is destructive- oral pharmaceuticals.

Batteries and capacitors require exposed foil along one or both edges.

Some coatings are made over structure such as circuitry- diagnostic test strips.
Requirements of good stripe coating

• Uniform coating thickness
  • Proper cavity design
  • Proper die shim thickness for optimized die pressure
• Accurate width control
  • Shim sets width
  • Fine tune width with die vacuum
• Good edge quality
  • Shim Modifications - No heavy edge bead
  • Die vacuum - No saw tooth or waviness
• Proper alignment of stripes
  • Accurate shim design and fabrication
Patch Coating:
Expanding on the issues that make stripe coating desirable. Sometimes uncoated substrate is required around the full perimeter of a coated part.
- Lead attachment on micro-circuitry
- Cathode free area for batteries
- Protect cutting surfaces for die cut materials
- Minimize waste or additional processing
Anatomy of a Patch:

- Trailing Edge
- Machine Direction
- Leading Edge
- Patch Length
- Space
Requirements for good patches:

- Good machine direction edges
- Good leading edge
  - No heavy build up at the start of the patch
  - Accurate and repeatable timing
- Good trailing edge
  - Edge should be straight and clean
  - No feathers or drip lines
- Uniform coating thickness throughout Patch
How to achieve good patches:

• Good machine direction edge
  • Similar to full width and stripe coating, machine direction edge quality is controlled by:
    • Proper cavity design for uniform fluid velocity from edge to edge
    • Proper die shim thickness for optimized die pressure
    • Shim design to minimize flow disturbances at the edges of the slot opening
How to achieve good patches cont:

- Good leading edge
  - If moving the die; proper timing of the fluid start with the die return
  - Coating fluid pressure balance when diverting between coating and recirculation
  - Proper timing of fluid replace and divert valve
How to achieve good patches: cont:

• Good trailing edge
  • Proper timing of die retract with divert valve
  • Coating bead must be consumed before the die retracts
  • With displacer system coating bead is consumed when fluid is displaced
How to achieve good patches: cont:

• Uniform coating thickness throughout Patch
  • With proper balance of coating fluid pressure on either side of divert valve the die reaches steady pressure almost instantly and remains steady state throughout the patch
Conclusion:
With high quality mechanical design and engineering along with proper electronic controls it is possible to make extremely accurate patches on a roll to roll system using a slot die.