Performance Liner for Digitally Printed PSA Films

AIMCAL Fall Technical Conference
10/7/07
Overview

- Liner Development for Graphics/Signage
- New requirements for Digital Printers
- Manufacturing targets for Base Paper Production
- Focus on the treatment of the non-silicone side to optimize for end use application
- Verify through SEM microscopy and surface stain testing
- Comparisons to “standard” liners
Evolution

- Liners for Graphics and Signage
  - Roll to Roll applications
    - 78# clay coated liner
    - 90#/96# PCK layflat liner
  - Converting method
    - Plotter Cutters
    - Vacuum Tables
Evolution - Various Liners

- Clay coated base for Cast Vinyl
  - Commercial Graphics
    - 2 mil, 3 mil film for fleet marking,
    - Films for indoor/outdoor signs etc
    - Floor graphics
  - Reflective Products
    - Reflective Tapes
    - Traffic Control markings
    - Reflective Signage
Evolution Cont.

- Base paper for 78# liner
  - Traditional carrier
  - Layflat carrier
    - Clay 2 Sided liner
- Base paper for PS Stamp
  - Modified 78# carrier
Digital Printers

- Wide format printing
- Indoor/Outdoor Graphics
- Backlit Signage
- Floor Graphics
- Four, six or eight colors
- Letter cutting
Digital Printers - Why not a standard liner?

- Wide format printing - layflat
- In register feeding - no slippage
- Soft, ink reactive substrates - no transfer
- Elevated temperatures - stability
- Economics - best value
Digital Printers cont.

- Traditional 78#
  - Limited layflat
  - Backside transfer
    - Silicone
    - Logo print

- Traditional PCK
  - Feeding issues -> slippage
  - Backside transfer
  - Heat softening
Digital Printers - Define the liner requirements

- Top down
  - Silicone system
    - Release, stability, coverage
  - Base Paper
    - Good layflat
    - Exact, precise feeding
    - Adequate strength
    - Consistent, uniform caliper
    - Zero ink/silicone transfer
Technical Approach

Rawstock Run Average
8/27/06 - 8/27/07

- Basis Weight
  - Units -> #/3000 sq. feet
  - Target 64.5
  - Actual -> 65.5
    - Low -> 63.9
    - High -> 67.5
  - Std dev. -> 0.65
Technical Approach

Rawstock Run Average
8/27/06 - 8/27/07

- Caliper
  - Units -> mils
  - Target 5.2 (non supered)
    - Actual -> 5.15
    - Low -> 4.825
    - High -> 5.375
    - Std. Dev. -> 0.07125
Technical Approach

Rawstock Run Average
8/27/06 - 8/27/07

- Tear Strength
  - Units -> grams
  - Targets -> MD 77, CD 94
    - Actual -> MD 77.1, CD 93.8
    - Low -> MD 66, CD 76
    - High -> MD 90, CD 109
    - Std Dev. -> MD 5.51, CD 7.21
Technical Approach

Rawstock Run Average

8/27/06 - 8/27/07

- Tensile
  - Units -> #/inch
  - Targets -> MD 50, CD 20
    - Actual -> MD 51.4, CD 21.3
    - Low -> MD 38, CD 16
    - High -> MD 61, CD 26
    - Std Dev. -> MD 4.01, CD 1.76
Technical Approach
Rawstock Run Average
8/27/06 - 8/27/07

- Scott Internal Bond (SIB)
  - Units -> lbs/sq inch
  - Target -> 0.15
    - Actual -> 0.16
    - Low -> 0.11
    - High -> 0.23
    - Std Dev. -> 0.029
Technical Approach

Rawstock Run Average
8/27/06 - 8/27/07

- MB Video Formation
- Units - Subjective scale (0-100)
  - Target -> 30
  - Actual -> 34.4
  - Low -> 30
  - High -> 38.4
  - Std. Dev -> 1.63
Technical Approach

Rawstock Run Average
8/27/06 - 8/27/07

Furnish

Softwood/ Hardwood Blend

Target

- 45% Pine (softwood, think strength)
- 35% Short (hardwood, think formation)
- 20% Broke (machine recycled, think layflat)
- Adjusted to meet Physical properties
Technical Approach
Basestock Run Average
8/27/06 - 8/27/07

- Clay coating
  - 1st head coating for Silicone Holdout
    - Composition (Proprietary Ground coat)
      - High holdout, film forming binders - 25%
      - Smooth clay, small particle size - 75%
  - Coat weight target
    - 7#/ 3000 sq feet
  - Application
    - Smooth rod
Technical Approach

Basestock Run Average
8/27/06 - 8/27/07

- Clay Coating
  - 2nd head coating
    - Designed for layflat, feeding, and offset
    - Composition (Proprietary)
      - “Open” coating
      - 10-15% binder, 85-90% clay
  - Coat weight target
    - 9#/3000 sq feet
  - Application
    - Smooth rod
Technical Approach
Basestock Run Average
8/27/06 - 8/27/07

- Supercalendering after coating
  - 8 nips -> full stack supering
  - Alternating synthetic/steel rolls
- Moderate pressure
  - 15% bulk reduction
  - Smoothness
  - Roll quality/Roll hardness (distortion)
Technical Approach

Basestock Run Average
8/27/06 - 8/27/07

- Basestock Properties
- Moisture
  - Units -> %
  - Target -> 4
  - Average -> 4.1
  - Min. -> 3
  - Max -> 6.4
Technical Approach
Basestock Run Average
8/27/06 - 8/27/07

- Basestock Properties
- Caliper
  - Units -> mils
  - Target -> 4.5
  - Average -> 4.65
  - Min/Max -> 4.275/5.35R
Technical Approach
Basestock Run Average
8/27/06 - 8/27/07

- Basestock Properties
- Gloss
  - Units -> %
  - Felt (silicone side) target -> 65
  - Felt average -> 66.9
  - Felt min/max -> 50R/76
  - Wire target -> 35
  - Wire average -> 38.5
  - Wire min/max -> 26/57
Technical Approach

Basestock Run Average

8/27/06 - 8/27/07

- Basestock Properties
- Smoothness PPS
  - Units -> PPSU (air flow rate over surface)
  - Felt side (silicone) target -> 1.5
  - Felt side average -> 1.6
  - Felt side min/max -> 1/2.5
Technical Approach

Basestock Run Average
8/27/06 - 8/27/07

- Basestock Properties
- Densometer
  - Units -> Seconds
  - Target -> 200,000
  - Average -> 177,212
  - Min/Max -> 10,800R/641,000
Technical Approach

Basestock Run Average

8/27/06 - 8/27/07

- Basestock Properties

- Dyed Oil Holdout - Check
  - Functional side - high holdout, pinhole free
  - Backside - low holdout
  - Visual standards
Dyed Oil Testing
Silicone Liners

- Controlled viscosity Mineral oil
- Applied to the surface for 30 seconds
- Wiped off with clean paper wipe
- Dyed for easy stain interpretation
Dyed oil Testing
Digital Liner
Dyed oil - Silicone Side

- High holdout clay coating.
- Very little evidence of oil absorption
- No pinholes
Digital Liner
SEM Photograph - Silicone

- Clay coated surface
- Heavily coated
- Supercalendered
- Complete coverage
- Uniform coverage
Modified 78# Liner
Dyed oil - Backside

- Lightweight application of clay
- 2-3#/3300 sq. feet
- Not supercalendered
- Mottled, blotchy absorption
- Indicates light application of coating
Modified 78# Liner
SEM Photograph - Backside

- 3# Clay coating on back
- Fibers are covered, but still visible through clay
- Surface is rough, uneven
78# Backside Dyed Oil

- Light application of clay -> wash coat
- 2-3#/3300 sq.feet
- Uneven absorption
- Dye stain characterize by blotchy areas of high absorption and light areas of low absorption.
78# Liner
SEM Photograph - Backside

- 3# Clay coating
- Supercalendering flattens (densifies) the fibers and clay
- Smoother but still uneven
- Holes in the coating apparent
Digital Liner Backside

- Even absorption, even color
- Deep color, good absorption
- Indicates even coat weight
- Indicates even distribution of clay
Digital Liner
SEM Photograph - Backside

- Heavy clay coating
- Supercalendered for smoothness
- Good uniform coverage
- Even distribution of coating
- Complete fiber coverage
Technical Approach - Liner

- Silicone coating
  - Choice of Silicone
    - Solventless for water based adhesives
      - Pt catalyzed, high crosslink density
      - Flat release profile vs. peel speed
      - Higher COF surface
      - Remoisturized to 3.5% target
      - Finished with slight reverse curl
Technical Approach - Liner

- Silicone coating
  - Choice of Silicone
    - Solventless - solvent adhesives
    - Pt Catalyzed
    - Slip additive for low COF
    - Acts like solvent tin for adhesive creep
    - Remoisturized to 3.5%
    - Reverse curl for layflat
Technical Approach - Liner

- Silicone Coating
  - Choice of Silicone
    - UV system for water based adhesives
    - Epoxy cure - low extractables
    - High COF
    - UV cure, no heat -> 4 - 4.5% moisture
    - Very stable release
Technical Approach - Liner

- Silicone Coating
  - Choice of Silicone
    - Emulsion for water based adhesives
    - High crosslink density - flat release profile
    - Low COF, allows for some adhesive creep
    - Very smooth surface - uniform adhesive coating
    - Able to be “tinted”
    - Remoisturized to 3.5%
Tinted Liner
Emulsion Silicone

AIMCAL*2007
Finished Product

- Silicone options
  - Available in Solventless, Emulsion or UV
  - Customizable for a variety of release requirements
  - UV allows for higher liner moisture
  - Emulsion provides a smoother surface and can be tinted
  - Solventless can perform like a solvent tin system
Finished Product

- **Basestock**
  - Good layflat
    - 3.5 - 4.5% moisture
    - Heavy clay coating on backside for stability/balance
  - Backside coating
    - Allows for good anchorage of Logo print (no ghosting or transfer)
    - Accounts for any residual silicone (no transfer to film print surface)
    - Provides excellent feeding
Layflat Testing

- Adhesive coat, laminate vinyl
- Cut samples to 8” x 8” squares
- Test at 70 deg F. 50% RH
- Test high humidity > 80%
- Test at low humidity < 25%
Modified 78#

Layflat

- Wavy edges on all sides
- Uneven edge curl
- Edge “darts” extending into the middle of the sample
Modified 78#
Layflat cont.
78# Liner
Layflat

- Slight waviness, not as bad as “modified” 78#
- Edge darts extending into the middle of the sample
- Slight lift, at corners.
78# Liner
Layflat cont.
Digital Liner
Layflat

- Uniform edges
- No evidence of waviness or cockle
- Slight lifting on edges, but consistent on all sides
Digital Liner Layflat cont.
Finished Product

- Basestock cont.
  - Good caliper profiles - dye cutting, letter cutting
  - Good SIB - no delamination with weeding
  - Good strength for adhesive coating and converting