Stickies: Control Methods

Richard A. Venditti(1), Mahendra Doshi(2)

(1) North Carolina State University
Dept. of Wood and Paper Science

(2) Progress in Paper Recycling
Control and Removal Methods for Stickies

- **Use of environmentally benign adhesive (recyclable adhesive)**
- **Avoidance:** Control of recovered paper quality
- **Mechanical removal:** screening and water clarification
- **Chemical control:** polymers surfactants, others
- **Passivation with inorganics**
- **Enzyme hydrolysis**
- **Physical adsorption to paper fibers:** retention
- **Dispersion**
- **Protection:** treatment of equipment to limit deposits
- **Mill shut down for clean-up**
Governmental efforts to promote benign adhesives

- US Postal Service, USPS P1238-F, qualifies products,
  - all stamps are EBA

  - Mandates use of EBA’s for government purchases
  - Not all tapes and labels are EBA

- Cost circa $100,000,000 in United States
Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- **Avoidance:** Control of recovered paper quality
- Mechanical removal: screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- Physical adsorption to paper fibers: retention
- Dispersion
- Protection: treatment of equipment to limit deposits
- Mill shut down for clean-up
Recovered Paper Quality Control

- Stickies
  - Plastic films
- Dirt
  - Brightness
- Groundwood
  - Glass, Metal
- Strength
  - Municipal trash
- Coated
  - Uniformity
What to measure in bales if stickies are the concern?

1. Visually inspect outside of bales for stickers.

2. Visually inspect bale after opening.

3. Can supplier/location/grade be identified with high stickies content: keep track?

4. Reject bales with justification or simply discuss needs with supplier.
Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- Avoidance: Control of recovered paper quality
  - **Mechanical removal:** screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- Physical adsorption to paper fibers: retention
- Dispersion
- Protection: treatment of equipment to limit deposits
- Mill shut down for clean-up
Pulper Performance

- Often can not change parameters
- Gentle pulping
- Drum pulping
- Pre soaking
- Short pulping time
- Low temperature
- Low pH
Analysis of Macro Stickies - SOW
M. A. Pikulin, AF&PA and USPS Joint Conference to Address PSA Issues, June 1996

[Bar chart with different categories and polymers, such as Styrene-Acrylate, SBR, PVAC,EVA, Acrylate, and SIS Copolymer, showing comparisons in different processing stages: Pulper, Screen, Flotn., and Product.]
Intense Forces in a Pressure Screen Break/Deform Adhesives: Decreases Screening Efficiency

“Thousands of small particles generated”

Shredding makes particles more 1-dimensional

Accepts + Rejects

Particles in 1 m²

Feed

Particle Size, mm²
Improved screening efficiency:

• Lower consistency
• Lower pressure drop
• Lower temperature
• Lower passing velocity
• Feed forward versus cascade arrangement
SCREENING SYSTEM

Simple Common Sense Principles

1. Do not mix a clean stream with a dirty stream.

2. Avoid recirculation of contaminants.
SCREENING SYSTEMS
Conventional Cascade Arrangement

FEED ➔ ACCEPTS ➔ REJECTS
SCREENING SYSTEM

Cascade

Forward

?
SCREENING SYSTEM

0.008” slots

0.006” slots

Or higher reject ratio
SCREENING SYSTEMS
Forward Flow Arrangement

FEED

ACCEPTS

REJECTS
Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- Avoidance: Control of recovered paper quality
- Mechanical removal: screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- Physical adsorption to paper fibers: retention
- Dispersion
- Protection: treatment of equipment to limit deposits
- Mill shut down for clean-up
Improved **micro** stickies removal efficiency:

- Improvement to the water clarification process.
- Maximum air addition and retention time.
- Proper type/dosage/mixing of chemicals.
- Routine testing of suspended solids removal.
- Additional clarifier capacity
Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- Avoidance: Control of recovered paper quality
- Mechanical removal: screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- Physical adsorption to paper fibers: retention
- Dispersion
- Protection: treatment of equipment to limit deposits
- Mill shut down for clean-up
Additives to Combat Stickies

• **Solids/Slurry**
  – Inorganic (Talc)

• **Liquids/Emulsions**
  – Inorganic (Zirconium Compounds)
  – Organic
  • Cationic fixatives to fibers
  • Anionic (Negative Charge)
  • Nonionic (Surfactant)—stabilize adhesive particles
  • Starch or cyclodextrins

• **Enzymes: hydrolyze ester groups**
  making stickies more stable
U.S. Pat. No. 3,992,249, Farley, November 1976 teaches using an aqueous solution of an anionic polymer containing hydrophobic-oleophilic linkages and hydrophilic acid linkages in pulp making system. These polymers are used to inhibit pitch deposition in these systems.

U.S. Pat. No. 4,190,491, Drennan et al., February 1980 teaches controlling pitch using a water-soluble linear cationic polymer. The polymers can contain vinyl acetate groups.

U.S. Pat. No. 4,765,867 Dreisbach et al., August 1988 teaches using a water-soluble quaternized polyamine ionene polymer to inhibit pitch deposition from pulp.

U.S. Pat. No. 4,846,933, Dreisbach et al., July 1989 teaches pitch control using a polymer containing polymerized units of methyl vinyl ether having methyl ether groups.
Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- Avoidance: Control of recovered paper quality
- Mechanical removal: screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- **Physical adsorption to paper fibers: retention**
- Dispersion
- Protection: treatment of equipment to limit deposits
- Mill shut down for clean-up
Physical adsorption to paper fibers: retention

- Cationic polymers with high charge density and low MW to fix anionic stickies to anionic fibers
- Possibility to use starch, proteins, alum and others…
- Needs good mixing in stock prep area
- Requires passivation of papermaking equipment
Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- Avoidance: Control of recovered paper quality
- Mechanical removal: screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- Physical adsorption to paper fibers: retention
- **Dispersion**
- Protection: treatment of equipment to limit deposits
- Mill shut down for clean-up
Dispersion

- **Dispersing System:**
  - Process stock is dewatered to 30%K
  - Clods of stock are broken in the breaker screw
  - Steam introduced into a heating screw to increase temperature to 185-245 C
  - Stock fed to dispersing unit
  - Stock is diluted and agitated for further processing
Single Shaft Kneader

- Process stock is dewatered to 30% K
- Stock enters a feed screw, steam or bleaching chemical may be added
- Stock is kneaded
- Stock is discharged, diluted and agitated for further processing
# Kneading vs. Dispersion

Methods to decrease contaminant size.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Dispersion</th>
<th>Kneading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tappi Dirt Reduct.</td>
<td>75%</td>
<td>85%</td>
</tr>
<tr>
<td>Toner Reduct.</td>
<td>yes</td>
<td>better</td>
</tr>
<tr>
<td>Stickies Reduct.</td>
<td>better</td>
<td>no effect</td>
</tr>
<tr>
<td>Fiber Cutting</td>
<td>substantial</td>
<td>none</td>
</tr>
<tr>
<td>Fines Generation</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>
Dispersion

– Must have excellent washing and water clarification directly after dispersion
– Should use an additive to pacify the particles
– Otherwise, the problem will worsen for papermachine
– Not recommended, energy intensive and harm to the fibers
Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- Avoidance: Control of recovered paper quality
- Mechanical removal: screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- Physical adsorption to paper fibers: retention
- Dispersion
- **Protection: treatment of equipment to limit deposits**
- Mill shut down for clean-up
Prevention of pitch and stickies deposition on paper-forming wires via adsorption of a cationic polymer associated with anionic species

• Deposition of colloidally dispersed pitch and stickies on papermachine wires etc is due to hydrophobic-hydrophobic interaction. “like dissolves like”

• Machine deposition is decreased if the hydrophobicity of the forming wires and/or the hydrophobicity and tackiness of the stickies are reduced.

• Cationic polymers associated with anionic species and these complexes subsequently adsorbed onto polyester forming fabric materials, rendering them hydrophilic and preventing deposition.

Control and Removal Methods for Stickies

- Use of environmentally benign adhesive (recyclable adhesive)
- Avoidance: Control of recovered paper quality
- Mechanical removal: screening and water clarification
- Chemical control: polymers surfactants, others
- Passivation with inorganics
- Enzyme hydrolysis
- Physical adsorption to paper fibers: retention
- Dispersion
- Protection: treatment of equipment to limit deposits
- Mill shut down for clean-up