Control of Sticky Material in Paper Machines Systems

Taiwan TAPPI Seminar
6th March 2013
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– Amazon Papyrus Chemicals
Introduction

• Pitch (wood-derived) and Sticky materials (synthetic origin – from recycled waste or broke) in paper machines often cause serious deposit problems on papermaking equipment.

• Ideally such materials would be completely removed in processes such as
  – screening,
  – cleaning,
  – washing,
  – or flotation de-inking.
Introduction

- In practice, tacky materials that remain in the fiber furnish can build up within the paper machine:
  - headboxes
  - forming fabrics
  - press section
  - dryer sections
- This built up sticky materials can reduce production efficiency.
- Product quality is likely to suffer, especially if deposited material ends up in the sheet.
Introduction

• Factors that promote agglomeration and aggregation of stickies include:
  – Increased water system closure
  – Poor contaminant retention in the sheet
  – Long residence times in stock chests
  – Higher temperatures (> 55°C)
Stickies/Pitch Control

Sticky

Pitch

AKD + CaCO3
Common Stickies Materials

- Pitch
- Hot melts
- Glues
- Adhesives
- Waxes
- Xerographic inks
- Latex from coated broke
- AKD/ASA hydrolyzates
Common Stickies Problems

• Light spots in the sheet
  – Wire filling

• Sheet crushing
  – Filled felts

• Poor sheet appearance
  – Hot melt and wax bleed
  – Stickies transfer onto the sheet

• Poor printability
  – Glues/waxes on the sheet surface

• Sheet picking and fiber rising
  – Press roll deposits
  – Dryer can deposits

• Downtime for batch cleaning
Stickies Deposition in the Forming Section

- Stickies on the wire interfere with stock drainage, leading to light spots and sheet holes.
- When the surface energy of the contaminant is less than the surface energy of the wire, the contaminant will spread across the wire, making removal more difficult.

\[ \gamma_{\text{Sticky}} < \gamma_{\text{Wire}} \]
Stickies Deposition in the Press Section

• Common deposition areas include: the felt, Uhle box covers (especially coating/ink binders), center rolls, and return rolls
• Temperature shocks “precipitate” stickies, especially hot melts and waxes
• Common problems include sheet crushing and deposit slough off
Stickies Deposition in the Dryer Section

- Common deposit areas are the first 5 dryer cans, the dryer fabrics, and calender rolls.
- Dry end deposition is strongly related to stickies size.

"Safe" Zone:
- 0% for Lower caliper sheet
- 35% for "Safe" Zone
- 80% for Paper Sheet Z-direction
Stock Treatment Applications

1. Encapsulation
2. Dispersant
3. Surfactant
4. Microfixation
5. Talc
6. Others – Bentonite, enzymes, passification etc
Encapsulation

- Encapsulation technology uses a nonionic hydrophilic polymer with a hydrophobic end, that stabilize and encapsulates the stickies.
- The hydrophobic portion of the polymer attaches to the hydrophobic stickies.
- The hydrophilic end remains in the water phase, encapsulating the stickies with a water loving coating.
Encapsulation Action Mode Illustration

- Hydrophobic chain (in sticky particle)
- Sticky particle
- Hydrophilic chain (water phase)
Encapsulation Control Mechanism

- The control strategy is to keep the tacky contaminants such as pitch and stickies in the smallest size by encapsulation so that agglomeration will not occur - encapsulated film surface being hydrophilic that the contaminants will stay in the water phase and will not deposit.

- With the contaminants being so small, they will now be able to be embedded in the sheet, reducing the deposition in the system and on the equipment.
Features/Benefits of Encapsulation

• Features
  – Will not upset wet end chemistry
  – Will not cause deposit slough off

• Benefits
  – Reduce stickies deposition on the wire, foils, wire return roll, press roll and press felt
  – Reduce sheet holes and picks
  – Reduce sheet breaks at the paper machine and winder
  – Improve sheet appearance
Case Histories For Encapsulation Technology
Case History - Pitch Control - 1000 MT/Day Fine Paper Machine

Sheet Spots Per 10000M Paper

<table>
<thead>
<tr>
<th>Date</th>
<th>Before Trial (23 days AVG)</th>
<th>During Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>15th Apr</td>
<td>50</td>
<td>0</td>
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<tr>
<td>16th Apr</td>
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<td>17th Apr</td>
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<td>40</td>
</tr>
<tr>
<td>19th Apr</td>
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<td>30</td>
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</table>

Delivering Value through People Chemistry
Pitch Control - 1000 MT/Day Fine Paper Machine

Sheet Holes Per 10000M Paper

<table>
<thead>
<tr>
<th>Date</th>
<th>Before Trial</th>
<th>During Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 days AVG</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>15th Apr</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>16th Apr</td>
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<td>0</td>
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<tr>
<td>18th Apr</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>19th Apr</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Stickies Control – 800 MT/Day Newsprint Mill

Dryer 4 Doctor Blade Stickies Deposit, ave weight/day
Case History - Stickies Control – 800 MT/Day Newsprint Mill

PM sticky Break - average per month

Trial started on 8th Oct

<table>
<thead>
<tr>
<th>Date</th>
<th>ave. sticky break</th>
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</thead>
<tbody>
<tr>
<td>Mar-08</td>
<td>1.871</td>
</tr>
<tr>
<td>Apr-08</td>
<td>1.600</td>
</tr>
<tr>
<td>May-08</td>
<td>1.258</td>
</tr>
<tr>
<td>Jun-08</td>
<td>1.900</td>
</tr>
<tr>
<td>Jul-08</td>
<td>1.355</td>
</tr>
<tr>
<td>Aug-08</td>
<td>1.484</td>
</tr>
<tr>
<td>Sep-08</td>
<td>1.000</td>
</tr>
<tr>
<td>Oct-08</td>
<td>1.667</td>
</tr>
<tr>
<td>Oct-08</td>
<td>1.240</td>
</tr>
<tr>
<td>Nov-08</td>
<td>0.458</td>
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</table>
Case History - AKD Hydrolyzate Control - 150 MT/Day Fine Paper

Doctor Blade

Deposit
Case History - AKD Hydrolyzate Control - 150 MT/Day Fine Paper
Dispersant
Dispersant

- **Anionic surfactants** consist of a hydrophobic end with a water soluble anionic charged end.
- The hydrophobic portion will attached to the surface of the pitch/stickies, and the anionic portion will increase the negative charge of the pitch/Stickies particles, which will repel each other and will not agglomerate to form pitch/stickies deposits.
Dispersant Working Mechanism

Hydrophobic stickies particles

Anionic Surfactant

Benefits:
- Make More Water Loving
- Reduce Aggregation
Dispersant

• These products are charged, so they can affect the performance of the cationic retention aids and the wet end chemistry as a whole.
Surfactant
Surfactant

• The surfactants consist of a **hydrophobic** portion coupled with a **hydrophilic** portion.
• The hydrophobic portion will attach to the surface of the pitch/stickies particle which will result in the hydrophilic end in the water phase, and this ends up with the pitch/stickies being water loving and less hydrophobic.
• Hence the pitch particles are less likely to agglomerate into larger pitch particles.
Surfactant Working Mechanism

Benefits:
- Become more hydrophilic
- Reduce aggregation
Surfactant

• The disadvantage of this mechanism is the weak bond between the surfactant molecule and pitch/stickies particle.
• Due to the weak bond, you get surfactant molecules in the water phase and the surfactants connected with the pitch/stickies particles.
• This can lead to cycle-up of surfactant in the system – excess foaming.
Microfixation
Microfixation is the adsorption of very low molecular weight cationic polymers on colloidal particles followed by the stable fixation of these particles together or to fibers.
Microfixation

• This application is not as effective on pitch as pitch is very low anionic charged
• More applicable for treating coated broke for white pitch due to stronger anionic charged environment in the coated broke treatment.
• Also the cationic polymer may affect the wet end chemistry of the paper machine system.
Talc
Talc

- Talc is a naturally occurring magnesium silicate having a platy structure and a high affinity for hydrophobic material.
- The flat surface of the talc plate is hydrophobic and easily binds to other hydrophobic organic materials such as colloidal pitch.
- The edge of the plate is hydrophilic and is wetted by the water. These properties allow the suspension of talc in water while exposing a large surface area for pitch adsorption.
- Small colloidal pitch particles adhere to the hydrophobic surface of the talc plate. This results in these particles being pacified and prevents their agglomeration and deposition.
Talc and Its Working Mechanism

1. **Hydrophobic site**
   - Talc

2. **Hydrophilic site**
   - Talc
   - Stickies

3. Talc
   - Talc
Disadvantages

• Large amounts of talc (5-10 kg/ton) must be fed in order to ensure sufficient pitch control.
• Talc bundle is unstable and can be broken by high shear.
Disadvantages

• Other disadvantages of using talc as pitch control are as follow:

  – Talc can get entrapped in machine deposition and add bulk to a deposit or get entrapped in a felt resulting in felt filling.
  – Talc is not very effective on purchased pulps due to the fact that purchased pulp contains pitch in its highest state of agglomeration.
Disadvantages

– Safety concerns handling talc bags and dusting of the talc (causing silicosis of the lungs).
– Talc can stabilize foam in the machine system. This can result in increased foam-related problems and deposition at the foam/air interface.
Mechanical Considerations For Stickies Control
### Specific Gravity of Contaminants

<table>
<thead>
<tr>
<th>Heavyweights</th>
<th>Lightweights</th>
</tr>
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<tbody>
<tr>
<td>Sand</td>
<td>Wax</td>
</tr>
<tr>
<td>Metal</td>
<td>Polyethylene</td>
</tr>
<tr>
<td>Clay</td>
<td>Styrofoam</td>
</tr>
<tr>
<td>Inks</td>
<td>Hot Melts</td>
</tr>
<tr>
<td>Shives</td>
<td>Adhesives (stickies)</td>
</tr>
<tr>
<td>S.G of water</td>
<td>1.0</td>
</tr>
<tr>
<td>2.0 - 2.2</td>
<td>0.9 - 1.0</td>
</tr>
<tr>
<td>6.0 - 9.0</td>
<td>0.9 - 1.0</td>
</tr>
<tr>
<td>1.8 - 2.6</td>
<td>0.3 - 0.5</td>
</tr>
<tr>
<td>1.2 - 1.6</td>
<td>0.9 - 1.1</td>
</tr>
<tr>
<td>1.0 - 1.3</td>
<td>0.9 - 1.0</td>
</tr>
</tbody>
</table>

S.G of water = 1.0
Stickies Control: Mechanical-Stock Prep

- Screens
  - Slot width
  - Preventive maintenance
  - Position: before/after sand cleaners
  - Stock temperature
Stickies Control: Mechanical-Stock Prep

- Light weight (reverse) cleaners
  - Consistency
  - Pressure drop
  - $2^\circ$ accepts handling: forward or cascade
Stickies Control: Mechanical Stock Prep

• Dispersion units (dispergers)
  – Typically the last unit operation before HD storage
  – Do not remove stickies; only reduce their size
  – Critical parameters
    • Temperature- usually above 90°C
    • Energy input (plate clearance)
    • Dispersion plate (tackle) condition
Stickies Control: Mechanical-Stock Prep

- **Water handling**
  - Water flows: forward or back
  - Clarifier effectiveness
    - Efficiency
    - Hydraulic capacity
    - Polymer dosing control
  - Water closure
    - Increased temperature: 55°C threshold
    - Contaminant loading after 80% closure
    - Critical fresh water applications
Stickies Control: Mechanical-Stock Prep

• Rejects handling
  – **Ideal**: screen/cleaner rejects -> DAF -> landfill
  – Good alternate: rejects -> mid ply
  – Poor alternate: rejects -> pulper
  • Stickies control becomes size management
  • Stickies will find a way through the process
  • No point in operating reverse cleaners in this setup
Aluminum Hydroxide Deposition Control in Acid Rosin Size System
Introduction

• The recommended pH range for rosin soap sizing is between 4 – 4.5 or maybe as high as 5 to favor the presence of trivalent aluminum, a hydrated form of Al$^{3+}$. Al$^{3+}$ is the species that appears to be most useful for the retention and "setting" of rosin soap size.
• The amount of alum is usually well in excess of the stoichiometric amount needed to react with the rosin. This makes sense when one considers the fact that alum also plays the roles of pH controller, scavenger of excess anionic charge, retention aid, and drainage aid.
Introduction

“Setting” of Rosin Soap

Soap form

Precipitated form

Anchoring group

Fiber surface

M. Hubbe
Introduction

- The rosin-alum system must maintain the pH between 4 – 4.5
- The graph below shows that at the lowest pH values, Al+3 has a strong charge that begins to decrease as the pH is increases.
- **Aluminum Hydroxide, Al(OH)3, a gelatinous precipitate**, begins to form at pH 4.8 and becomes essentially the sole species present above pH 5.0.
Distribution of Aluminum Species as a Function of pH at pH 4-11
Aluminum Hydroxide Deposit

• The aluminum hydroxide can form at the areas where neutral pH fresh water is sprayed in the rosin-alum acid system:
  – Headbox (breast roll)
  – Forming zone especially at the foil blades
  – Press section
Aluminum Hydroxide

• Appearance
  – White or grey in colour
  – Slimy and look liked biological slime
  – It is also referred to as “chemical slime”
Typical Treatment Program

• Adjust system pH to 4 – 4.5 (Highest at 5)
• Adjust shower pH to 4 – 4.5 (Highest at 5)
• AmiSperse AP8032
Questions?
Thank You