Novel Biobased Coatings for Barrier Papers

Presented by:
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Outline

• Motivation
  - Biodegradable disposable food service articles

• Concepts for biodegradable barrier papers
  - Leveraging base paper surface properties
  - Impact of coating formulations

• Conclusions
Motivation

• Growing legislation to reduce plastics in the waste stream
  - Local
  - Regional
  - National
• Brands responding
  - Sustainability goals
  - Reducing single-use plastic packaging

Photo credit: Shutterstock
Example #1 – Leveraging Base Paper Surface Properties

Methods and Materials

• Three 80 gsm base papers
  - 50% BHWK, 50% BSWK
  - Produced on pilot paper machine
    • Base 1 – Control
    • Base 2 – 5 wt% CNF added to furnish
    • Base 3 – 5 wt% CNF added to surface
Base Papers – Surface SEM 500X

Base 1 – Control (No CNF added)

Base 2 – 5 wt% CNF added to Furnish

Base 3 – 5 wt% CNF applied to Surface
Example #1 – Leveraging Base Paper Surface Properties

Methods and Materials

• Base papers lab coated with lab drawdown method
  - Coated 1 side
  - 3.6 gsm coat weight
  - Dried on steam heated drum with restraint

• Three coating formulations
  - 100% PVOH-1 (medium molecular weight, fully hydrolyzed)
  - 90% PVOH-1, 10% SE-1 (low substitution level, saturated)
  - 75% PVOH-1, 25% SE-1
Example #1 – Leveraging Base Paper Surface Properties

Polyvinyl Alcohol

\[
\left[ \text{CH}_2\text{CH} \right]_n
\]

Photo Credit: http://www.mercatel.nl/publications/metaalkunststof_00_aug.html
Example #1 – Leveraging Base Paper Surface Properties

Sucrose Ester

Photo Credit: RSC Publishing - Royal Society of Chemistry
Barrier Papers – Air Permeability

Air Permeability

Gurley Density, second/100 cc

Coated one side
Nominal 3.6 gsm CTWT

- Uncoated
- 100% PVOH
- 90% PVOH, 10% SE
- 75% PVOH, 25% SE

Base Paper

Control Internal CNF Surface CNF
Barrier Papers – Oil & Grease Resistance

![Oil and Grease Penetration Test](chart)

**Oil and Grease Penetration Test**

- **Coated one side**
  - Nominal 3.6 gsm CTWT

**Kit Test Number**

- **Control**
- **Internal CNF**
- **Surface CNF**

- **Base Paper**

**Tests:**
- Uncoated
- 100% PVOH
- 90% PVOH, 10% SE
- 75% PVOH, 25% SE
Barrier Papers – Water Repellency

Size Test

Hercules Size Test, in seconds

Coated one side
Nominal 3.6 gsm CTWT

Uncoated
100% PVOH
90% PVOH, 10% SE
75% PVOH, 25% SE
Example #2 – Impact of Coating Formulations

Methods and Materials

• Base Paper
  - 60 gsm
  - Bleached kraft paper
  - Commercially produced

• Surface Treatment
  - Puddle size press application – pilot scale
  - Coated 2 sides
  - 1.9 gsm coat weight – total both sides
  - Steam heated drier cans
Example #2 – Impact of Coating Formulations

• Four size press coating formulations were evaluated
  - 100% PVOH-2 (high molecular weight, medium % hydrolyzed)
  - 80% PVOH-2, 20% SE-1 (low substitution level, saturated)
  - 80% PVOH-2, 20% SE-2 (high substitution level, unsaturated)
  - 80% PVOH-2, 20% SE-3 (medium substitution level, saturated)
Barrier Papers

Effect of Formulation on Barrier Properties

- HST, sec
- Gurley Density, sec
- 3M Kit Test x 100

60 gsm Bleached Base
Pilot Puddle Size Press
1.9 gsm average P/U

Property Value

Uncoated  PVOH Only  PVOH + 20% SE-1  PVOH + 20% SE-2  PVOH + 20% SE-3
Conclusions

• The use of cellulose nanofibrils (CNF) in the base paper significantly improves the performance of barrier coatings.
  - Surface application of CNF dramatically reduces air permeability

• The addition of a hydrophobic material, like sucrose esters, to water-sensitive film formers can improve barrier coating performance including:
  - Oil and grease resistance
  - Water resistance
  - Air permeability
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• HS Manufacturing Group™ LLC
Thank you for your attention

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