BIO-BASED MATERIALS FOR FILM, HEAT SEALING & LAMINATION

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SPE / FLEXPACKON
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WHAT WE DO

1st Generation Ag feedstocks are a short term Bridging Tool

CO₂ + H₂O

Plants → Sugar → Manufacture

WHAT WE DO

Additives (Modifiers)
Adhesives
Coatings
Printing Toners
Specialty Lactates
Surfactants

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INVESTMENT IN INNOVATION AND R&D COLLABORATION TO GROW OUR INGELO FEEDSTOCK PORTFOLIO

Performance materials made by transforming whatever are the right, abundant, local resources

**GENERATION I**
- Today
  - Dextrose & Sucrose from cassava or corn starch, sugar cane or beet
  - “Bridging Crops”
- Scaled & Operating C\textsubscript{6} sugar fermentation technology

**GENERATION II**
- Developing
  - Lignocellulosics: Sugars from bagasse, wood chips, switch grass or straw.
- “Purchase” strategy
  - C\textsubscript{6} sugars from 3\textsuperscript{rd} party

**GENERATION NEXT**
- And next?
  - CO\textsubscript{2} to lactic acid technology?
  - CH\textsubscript{4} to lactic acid technology?
- “Develop” strategy
  - Methane fermentation
PREFERENCE: CRADLE-TO-POLYMER-PRODUCTION

Production Greenhouse Gas Emissions Including Biogenic Carbon Uptake

- **Ingeo**: 0.6
- **PP**: 1.9
- **HDPE**: 1.9
- **PET**: 2.7
- **PS**: 3.2

Peer Reviewed Benchmarking

**RETHINKING THE “TAKE-MAKE-WASTE” LINEAR MODEL**

“DECOUPLING FROM FOSSIL ECONOMY”

“BIO-BENIGN”

GREENPEACE'S “PYRAMID OF PLASTICS”

1. PVC
2. PU, PS, ABS, PC
3. PET
4. PE, PP
5. BIOBASED POLYMERS


Ingeo

naturally advanced materials
FILMS: AT A GLANCE

TRADITIONAL SOLUTIONS

WINDOW

MULTI-LAYER PKG

SKRINK SLEEVE

NEW LAMINATE SOLUTIONS

CLEAR + BARRIER

• Clear or metalized, high-barrier compostable lamination for packaging and lidding applications
• Targets dry goods

PAPER + BARRIER

• High O₂ and water vapor barrier
• Targets longer shelf life foods
• Allows two-layer pouch with performance of three-layer structure
• 100% renewable pouch when combined with paper

BETTER SEALANT

• Ultra-Light (9 micron) high performance sealant web
• Cost savings vs LLDPE
• Targets replacement of thin LLDPE sealants for VFFS and HFFS
• Pillow bags
• Pouches
• Single serve beverage

EarthFirst® UL

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SYNERGY: HIGH PERFORMANCE SEALANT WEBS

World leading bio-polymer producer with significant manufacturing know-how and extensive IP position

Offers a portfolio of naturally advanced low-carbon-footprint Ingeo functional materials, with properties tailor designed to specific end markets

EarthFirst™ UL are cost effective, high performance sealants, engineered to advantageously replace LLDPE in medium to small flexible packages where gas barriers are not required from the sealant

EarthFirst™ UL substrates are bio-based, have a low-carbon-footprint and are compostable
EarthFirst® UL

High performance sealant webs
light on the environment, light on your pocket

The EarthFirst™ UL value proposition is to advantageously and cost-effectively replace 1 to 3 mil LLDPE sealants by 0.35 to 0.47 mil (9 to 12 µm) Ingeo™ PLA based sealants

✓ Save cost by avoiding waste
  ▪ Material, time, transportation and floor space
✓ Enhance packaging performance
✓ Reduce environmental footprint
EarthFirst® UL

High yield advantage:

- 9µm (0.35mil) - 63,000 in²/lb
- 12µm (0.47mil) - 47,300 in²/lb

- 1.5 mil LLDPE - 20,000 in²/lb
- 2.0 mil LLDPE - 15,000 in²/lb

Cost: $/MSI = \frac{1000}{\text{yield}} \times \$/lb

- 9µm UL: 0.0159 lb
- 1.5 mil LLDPE: 0.0500 lb
- 2.0 mil LLDPE: 0.0667 lb

The **yield factor is 3.1 to 4.2X + favorable to the UL for cost effectiveness**

The UL advantages extend across all the production-conversion-utilization chain:

- Lower thickness > larger rolls
- ↓ **material cost & waste ($$$)**
- ↑ **packaging productivity ($$$)$**
- ↓ **machine downtime ($$$)**
- ↓ **transportation & floor space ($)**
POTENTIALS APPLICATIONS

Replacement of thin LLDPE sealants in small, streamlined packages, for VFFS and HFFS

- pillow bags
- pouches
- single-serve packages
- multi-wall bags
- paper laminations
TYPICAL STRUCTURES

48ga (met)PET // (1.25 - 2.0 mil) LLDPE
48ga PET // metPET // LLDPE
48ga PET // foil // LLDPE
BOPP // LLDPE
paper // LLDPE
paper // foil // LLDPE
Case study: 40” wide, 1,434,000 ft lamination: 12 mm metPET/1.5 mil LLDPE

Bill of materials:

30.3” OD metPET film: yield = 49,100 in²/lb, 120,000 ft, 1,375 lb (12 rolls = 16,500 lb)
31.2” OD LLDPE roll: yield = 20,000 in²/lb, 40,500 ft long, 972 lb (36 rolls = 34,992 lb)
26.5” OD UL roll: yield = 63,000 in²/lb, 120,000 ft long, 914 lb (12 rolls = 10,971 lb)

Adhesive coverage 0.90 lb/ream: 1,593 lb

1. Competitive cost of the UL sealant on a comparable coverage surface base:
   - 10,971 lb of EarthFirst™ UL X 34,992 lb of LLDPE
   - 3.2x less weight of sealant required

2. Reduced transportation costs:
   - 56,415 lb of EarthFirst™ UL raw materials and finished goods to transport versus 104,069 lb for the LLDPE
3. Improved lamination efficiencies: machine time and material waste
   1 hour laminator set-up, machine speed 1,000 ft/min, 5 minutes down time for each roll change and 500 ft of roll bottom waste
   - The time required for the UL lamination would be 25.9 hours
   - The LLDPE job would require 27.9 hours

4. Reduction of floor space usage
   - The roll stock storage volume for the LLDPE sealant (1,245 ft³) is 2.4 times larger than the UL (529 ft³).

5. Productivity of the packaging lines
   - The thinner laminated roll stock will benefit the packaging line with longer footages for the same OD compared to the thicker LLDPE and the thinner structure with lower seal initiation will favor the improvement of productivity

6. Regulatory compliance, sustainability and environmental impact
LET US HELP YOU MEET YOUR BIOFILM NEEDS WITH PERFORMANCE DRIVEN SOLUTIONS

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