Biopolymers for Paperboard Extrusion Coating and Converting

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Introduction

- Sustainable Packaging
- Paper & Bioplastics
- Extrusion Coating & Packaging
- Challenges & Opportunities
- Applications

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Linear Economy

Cradle to Grave

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Circular Economy

Cradle to Cradle

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Fossil vs. Bio

Fossil Polymers → Bio Polymers

- Reuse renewable resources
- Reduce carbon footprint
- Enhance sustainability profile

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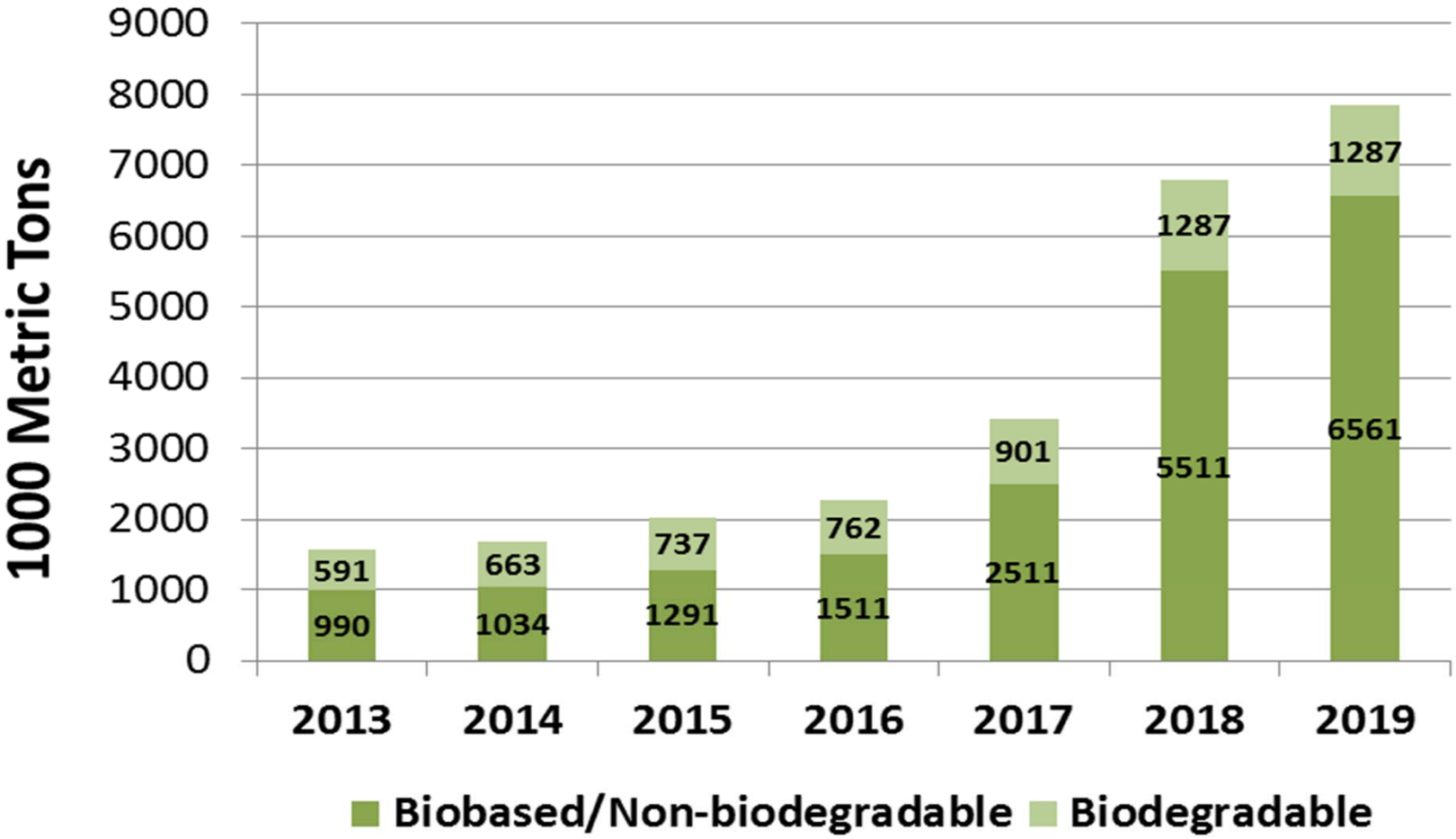
Global Bioplastics Production Capacity



Source: European Bioplastics, Institute for Bioplastics and Biocomposites, nova-Institute, Germany, 2015.

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Pulp & Paper

- Natural
- Renewable
- Biodegradable
- Compostable
- Recyclable

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The Best of Both Worlds

Paper + Bioplastics

=

Happy Marriage that Makes Good Environmental Sense

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Conventional Polymers vs. Biopolymers

Biodegradable \Biobased	Non-Biobased	Partially Biobased	Biobased
Biodegradable	PBS, PBSA, PCL, PGA, PVOH	Starch Blends, PLA Blends, PBS, PBAT	PLA, PBS, PHA, PHB, TPS, CA, Starch
Non-Biodegradable	PE, PP, PET, PBT, PA6, PA66	PBT, PET, PTT, PA6.10	PE, PA11, PA12, PA1010, PEF, PET, PTT

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Biodegradable/Compostable Polymers

- ASTM D6400, EN 14995/13432, ISO 17088
- Chemical: heavy metal limits
- Disintegration: <10% larger than 2mm
- Biodegradation: >90% CO_2 conversion, 6 months
- Ecotoxicity: no harmful effect on plant growth
- Compostable polymers are biodegradable, but not vice versa.
- Industrial composting

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Biobased Polymers

- Derived from plants or other renewable sources
- ASTM D6868, ASTM D7026
- Biobased content determined by carbon-14 dating
- Biobasesd polymers may or may not be compostable.

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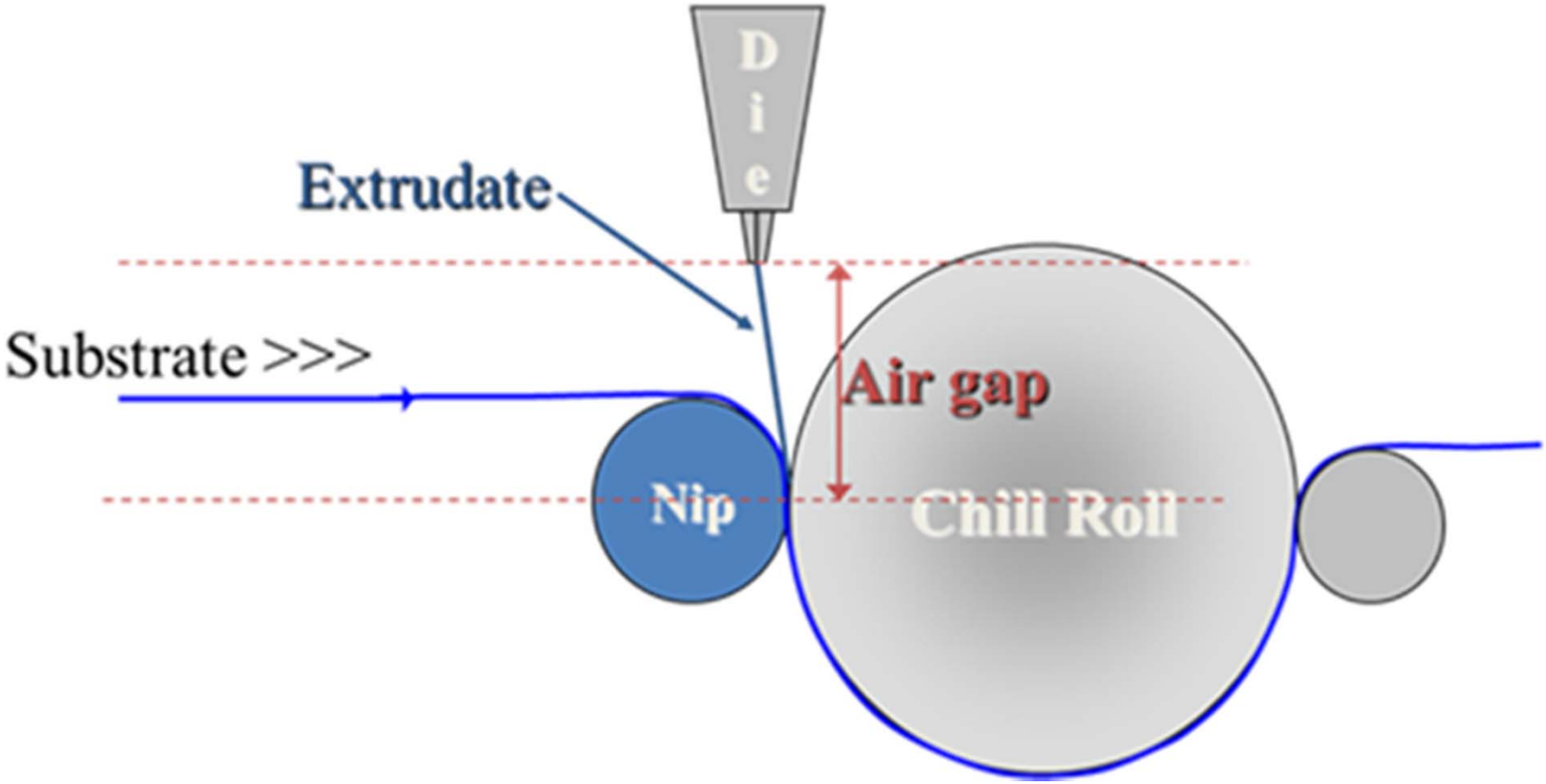
Paperboard Extrusion Coating



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Challenges

- High process temperature (>290°C/550°F)
- Polymer-to-paper fiber adhesion
- Good melt strength, low neck-in
- Good coat weight profile control
- Low/no smoke, defects, die lip buildups
- Easy to purge, clean up & change over

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Materials

Features \ Polymer	Fossil LDPE	Bio-LDPE	PLA	(Bio) PBS
Biobased	N	Y	Y	Y*
Commercially Available	Y	Y	Y	Y*
Flexible	Y	Y	N	Y
Heat Sealability	Excellent	Excellent	Fair	Good
FDA Food Contact	Y	Y	Y	Y
Liquid Barrier	Y	Y	Y	Y
Oil Grease Barrier	Y	Y	Y	Y
Industrial Composting	N	N	Y	Y
Home Composting	N	N	N	Y**
Marine Degradable	N	N	N	?

*Bio version in scale-up to commercial supply ** Limited grade

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Process & Equipment

- All extrusion coating challenges apply.
- PLA poor melt strength, curtain stability, neck-in; narrow process window
- Molecular modification
- Alternate biopolymers
- Proper screw configuration and die design for shear sensitive polymers

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Food Contact Regulatory Compliance

- Food packaging and foodservice products require proper food contact compliance and suitable Conditions of Use.
- US FDA 21 CFR176.170

A. High temperature heat-sterilized (e.g., over 212°F or 100°C)
B. Boiling water sterilized.
C. Hot filled or pasteurized above 150°F (65.5°C)
D. Hot filled or pasteurized below 150°F (65.5°C)
E. Room temperature filled and stored (no thermal treatment in the container).
F. Refrigerated storage (no thermal treatment in the container).
G. Frozen storage (no thermal treatment in the container).
H. Frozen or refrigerated storage: Ready-prepared foods intended to be reheated in container at time of use:
    1. Aqueous or oil-in-water emulsion of high- or low-fat.
    2. Aqueous, high- or low-free oil or fat.

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Functional & Packaging Performance

- Poly adhesion to paper fiber
- Heat sealability
- Moisture & liquid barrier
- Oil-grease resistance
- Printability
- Mechanical & physical properties

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Applications

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The Shift

Trends

- Urbanization
- Healthy lifestyle, environmental awareness
- Demographic change

Desires

- Convenience, on-the-go
- Fresh
- Ready meals

Needs

- Smaller package size in bulk
- Shelf-life extension
- Freeze-thaw-microwave-oven

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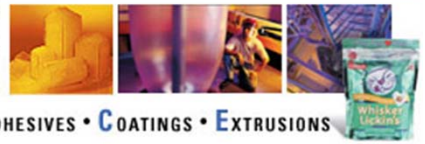

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Opportunities

- Fast, small-batch, customized converting
- High heat-resistance biopolymers for microwave and oven cooking
- Compostable biopolymers for liquid packaging
- Moisture & oxygen barrier for shelf-life extension
- Soil, fresh water, marine biodegradable

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Eco Economy & Packaging Value Chain

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Conclusions

- Eco-based circular economy
- Biopolymer innovation and technology
- High-performance biopolymer+paperboard hybrid packaging materials
- Challenges = Opportunities
- Emerging trends and needs

Acknowledgements

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  - Rahul Bhardwaj
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Thank you!

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