



Laminating Adhesives: Enabling Sustainable Flexible Packaging

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H.B. Fuller

Our Focus is Clear. Perfecting Adhesives.™

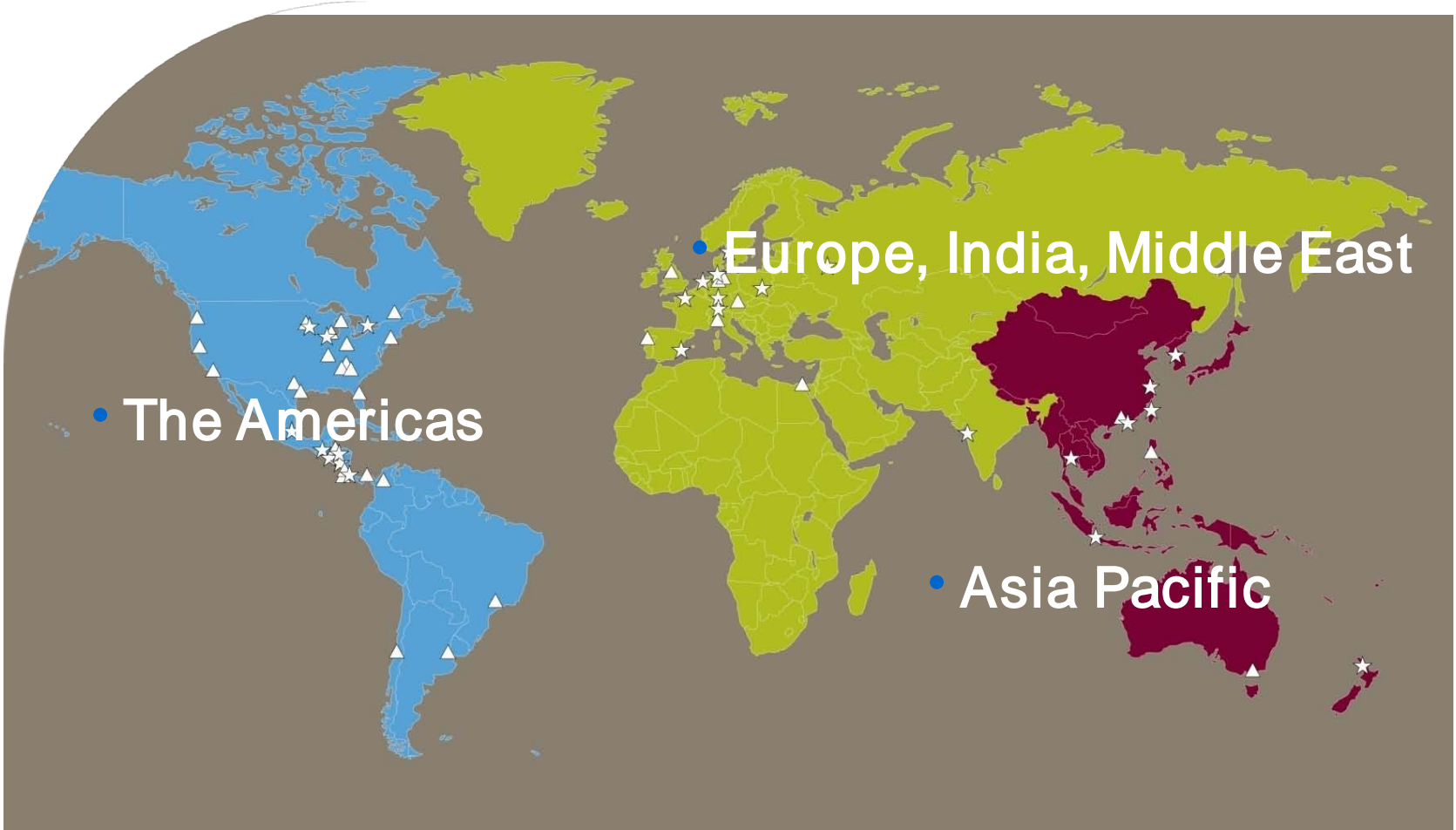
Agenda

- Who is HB Fuller
- Trends in Packaging
- What is a Flexible Package?
- Innovation



Global Organization

H.B. Fuller is organized geographically:

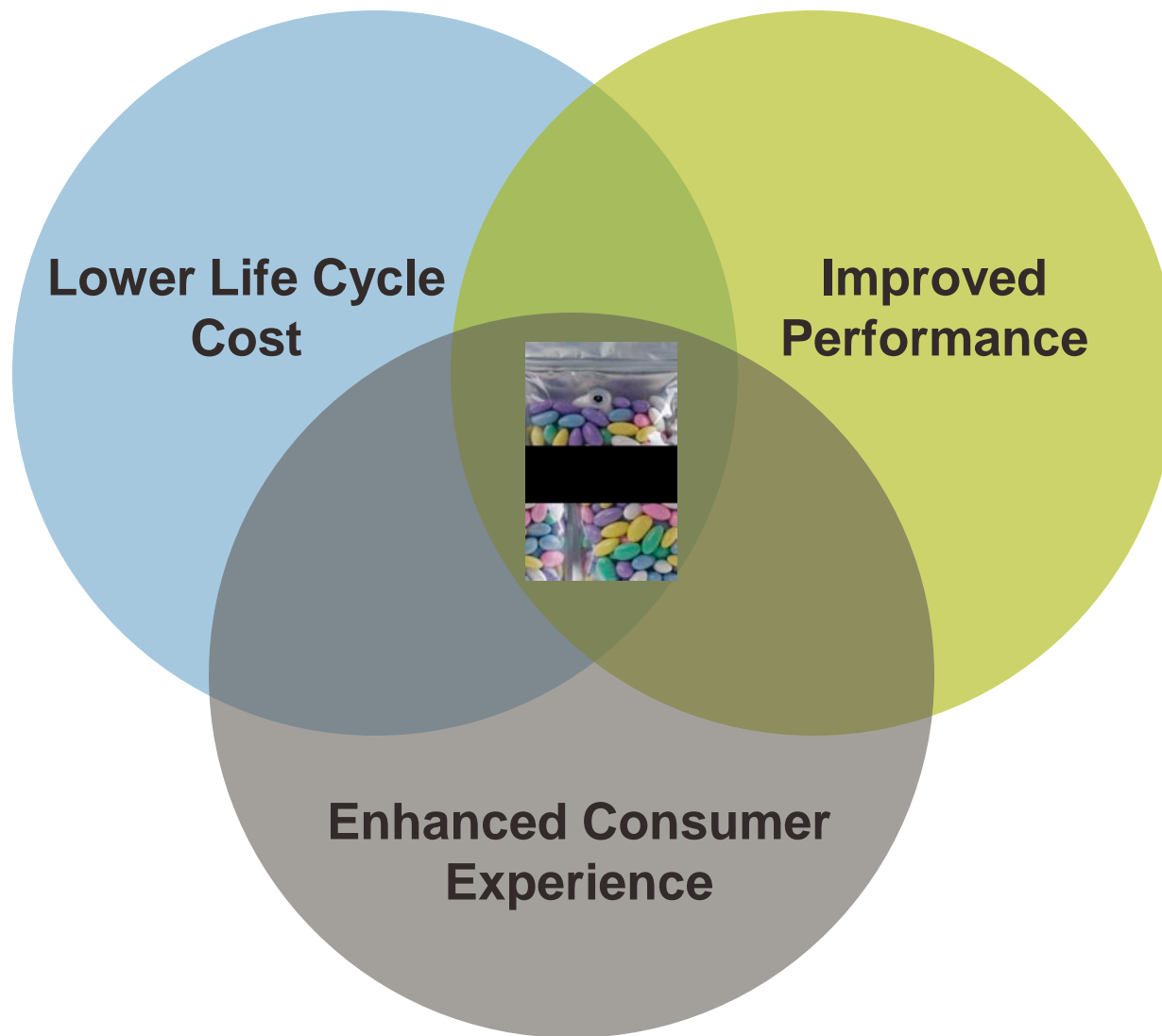


H.B. Fuller Company

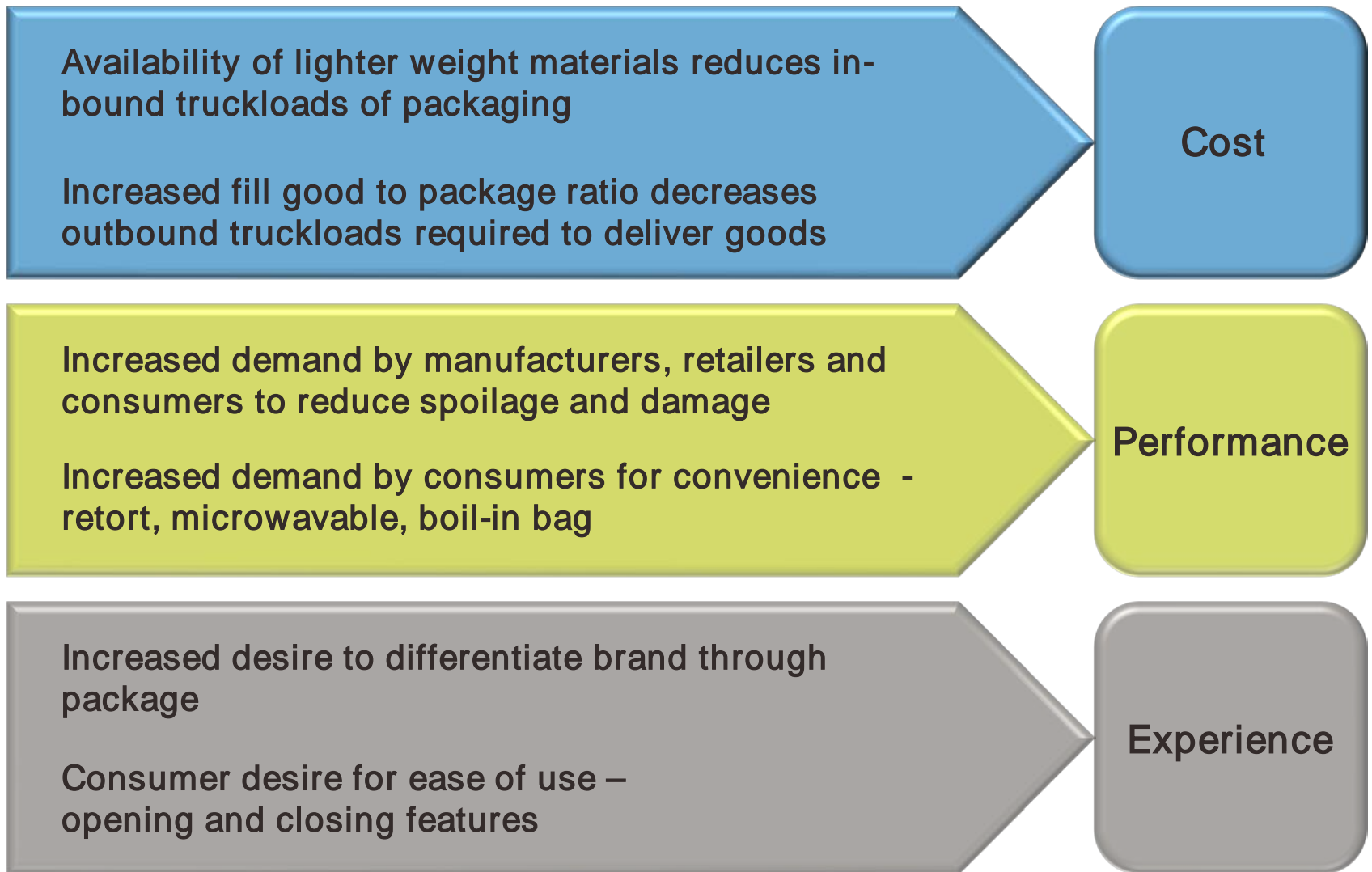
- 125 years of success as a manufacturer of specialty chemical products
- Headquartered in St. Paul , Minnesota
- Recognized for quality adhesives, sealants, coatings, and paints
- Global with direct presence in 39 countries, 3300 employees, and customers in more than 100 nations
- 2011 sales of \$1.56 billion
- Public company listed on NYSE (FUL)
- Component stock of the Standard & Poor's Small Cap Index (S&P 600)



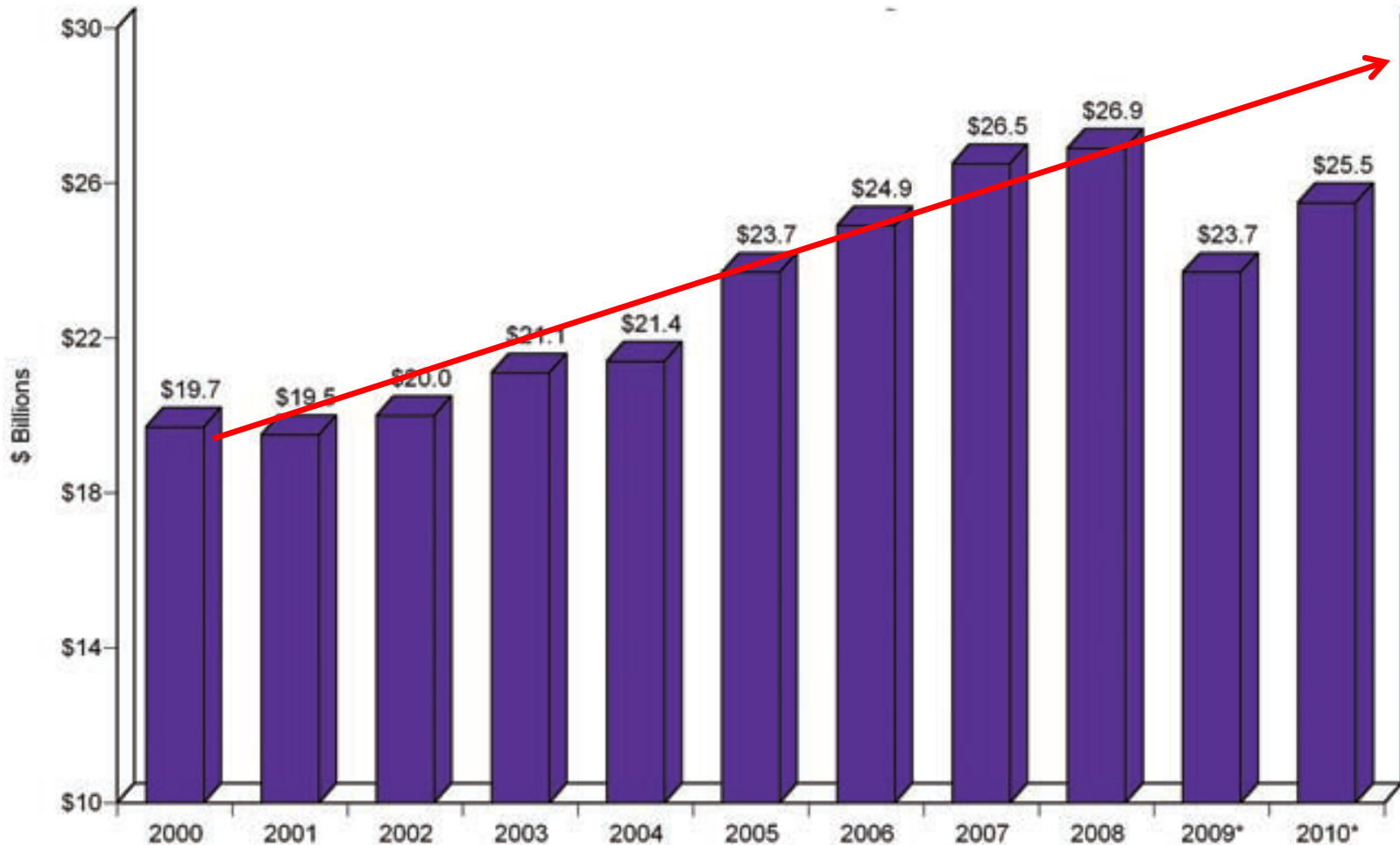
Trends in Packaging



Drivers of the Trends



Flexible Packaging Revenue, 2000-2010



Compound Growth Rate 2.6%/yr

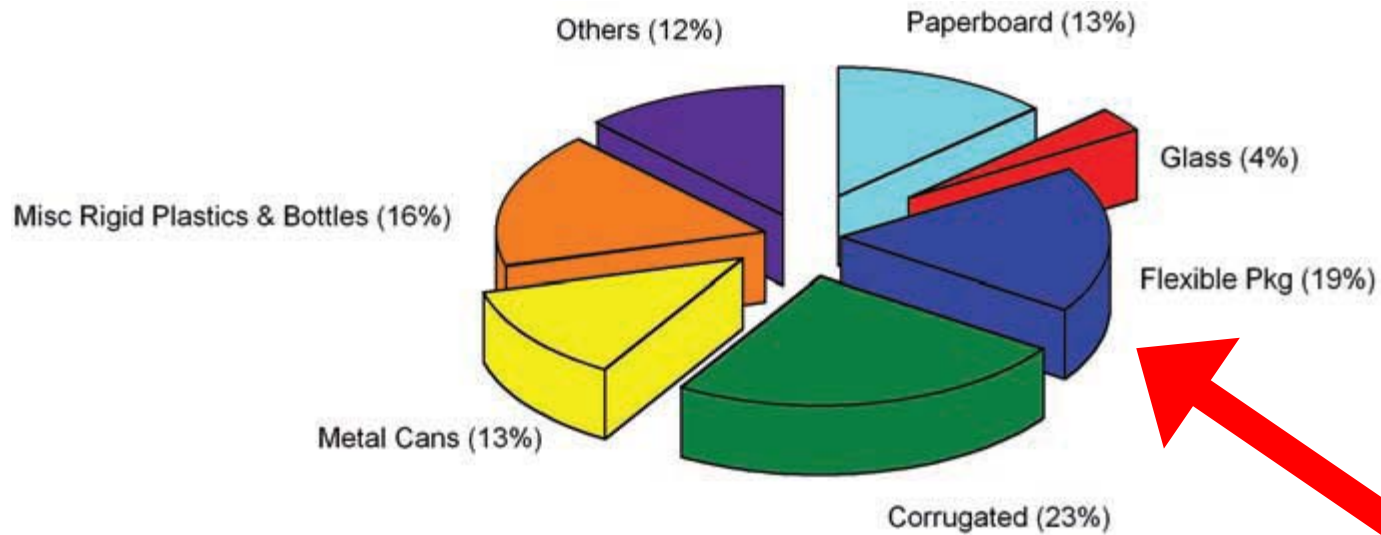
*FPA Estimate

Source: Census Bureau and Flexible Packaging

Association

Total U.S. Packaging Sales %

Breakdown by Segment



Total \$134 billion

Source: Latest Census Bureau ASM data and Flexible Packaging Association estimates

Packaging Requirements

- Contain food stuff
- Protect from vermin
- Protect from environmental contaminants
- Provide light barrier
- Control gain or loss of moisture and oxygen
- Resistance to components of the food stuff
- Billboard for the product and brand

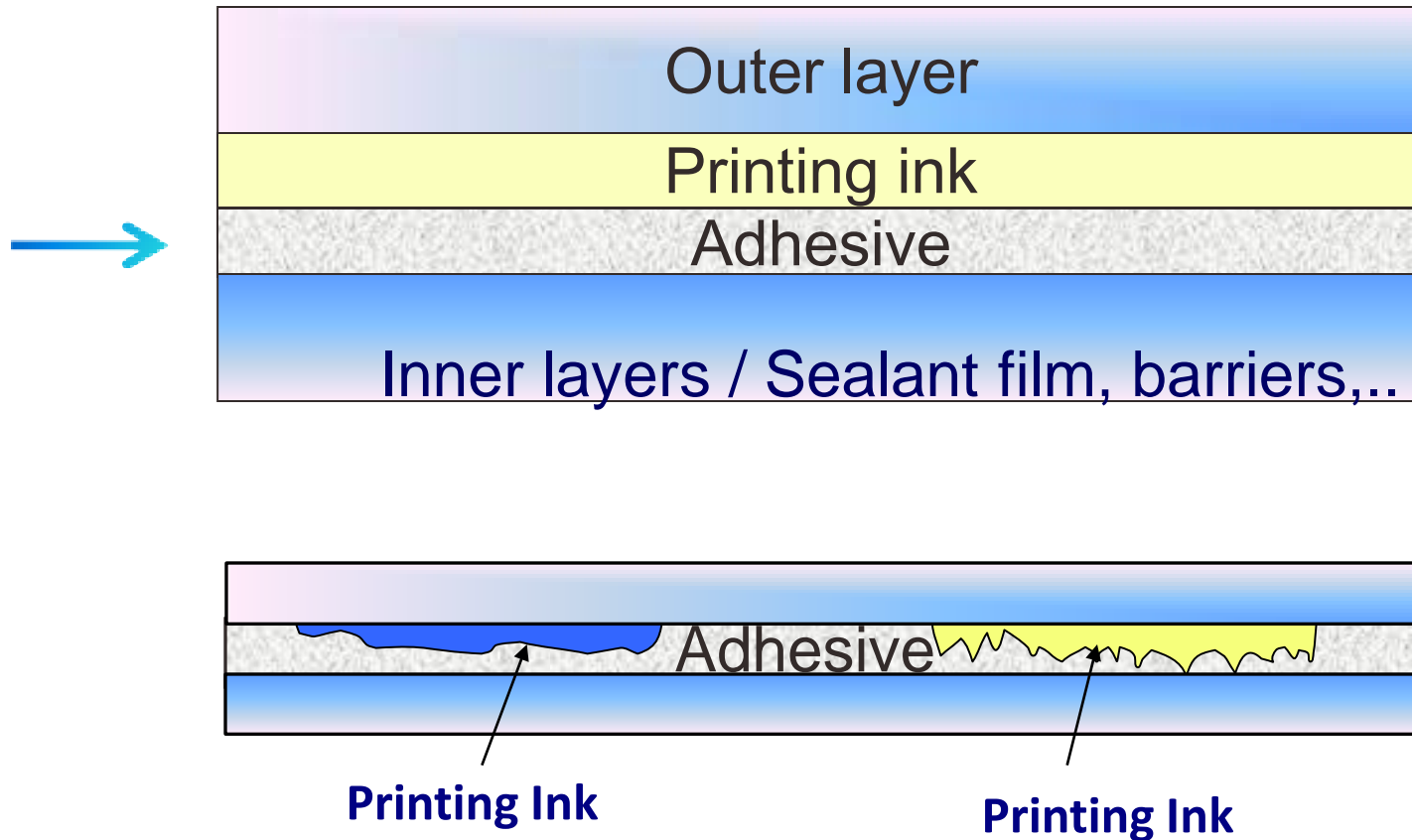
Performance/Protection

Flexible Packaging

- Single film cannot meet all package requirements
 - Protection/Barrier
 - Oxygen
 - Water
 - Aroma
 - Gas flush
 - Package forming
 - Sealing
 - Forming
 - Puncture
- Multiple films must be brought together via a lamination technique
 - Extrusion
 - Adhesive

Multiple Films = Performance

Laminated Structure



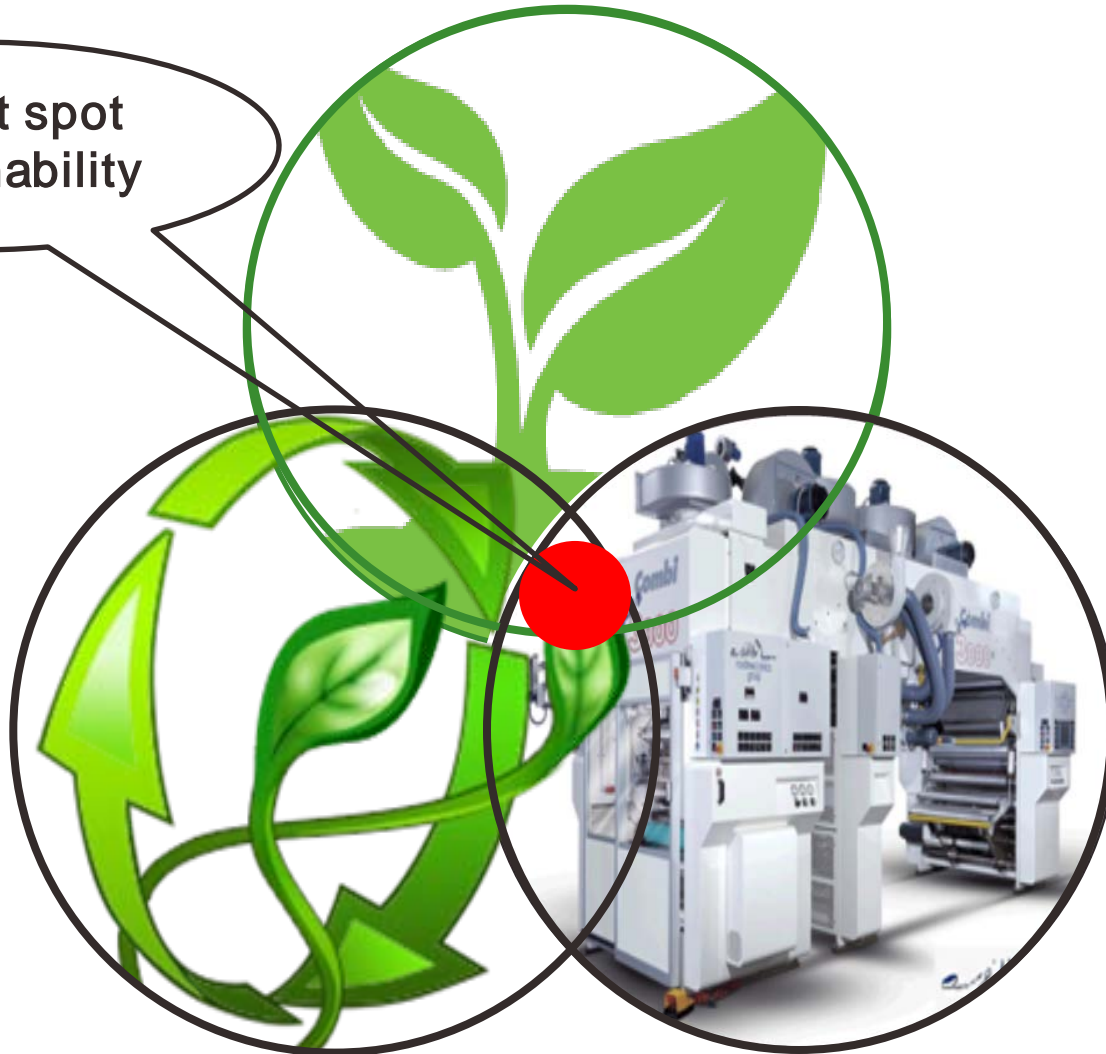
Flexible Packaging Converting Process



- **Print**
 - Provides brand image
- **Laminate**
 - Gives the resistance properties
 - Gives barrier properties
- **Slit, Pouch, and Fitments**
 - Gives ability to act as a container
 - Provides opening and closing features

What is Your Definition of Sustainability

The sweet spot
of sustainability



Sustainability in Flexible Packaging

A Sequence of Events

Today – Focus is on Films and Their Source

Where they come from

- Sustainable polymers for films
 - Print film
 - Sealant film
 - Functional
- Supply chain and scale – Economic sustainability

End of Life

- Recycling
- Composting
- Incineration



Sustainability in Flexible Packaging

A Sequence of Events



Future – Completes the Package Life Cycle

How a Package is Made

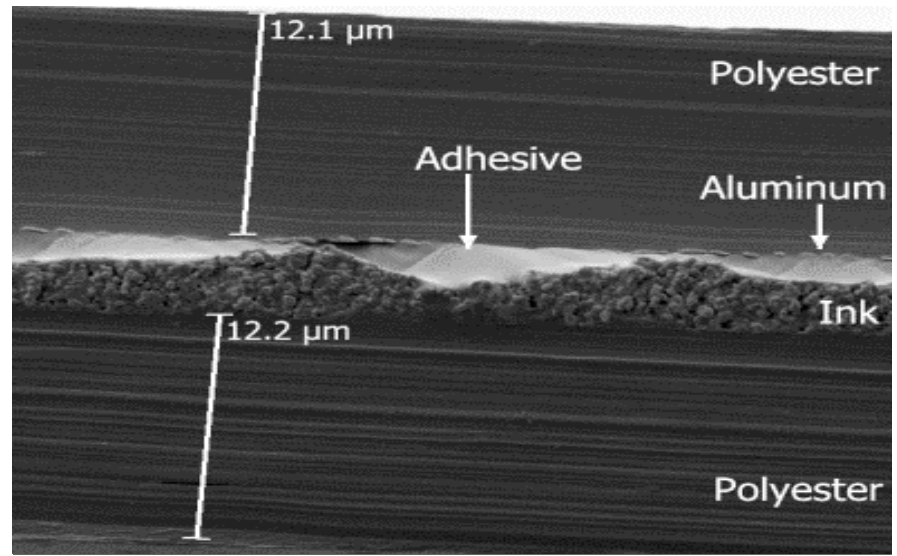
- Manufacturing processes
- Energy
- Waste

Secondary Components

- Adhesives
- Printing inks
- Barrier technology
 - Coating
 - Additives

Why is Adhesive Critical

- Avoid waste of film and contents from failure due to adhesive
- Aggregate film properties - performance
- Food protection
- Extended freshness – shelf life
- Format and fitments



Scanning Electron Microscopy (SEM)

Thickness 1-5 μ
~2-6% of a lamination is adhesive

Enabler of sustainability

ADHESIVES

Adhesives Today

- Can contain some renewable raw materials
- Bond a variety of films including those from renewable sources
- Facilitate sustainable manufacturing process
- Enable sustainable options of end of life



Renewable Raw Materials in Adhesives Today



- Renewable raw materials have been available for years
 - Starch
 - Casein
 - Rosin Esters
 - Terpenes
 - Fatty Acids
 - Fatty Alcohols
 - Dextrin's
 - Modified Cellulose
- Performance has been the challenge

Variety of Combinations for Flexible Packaging

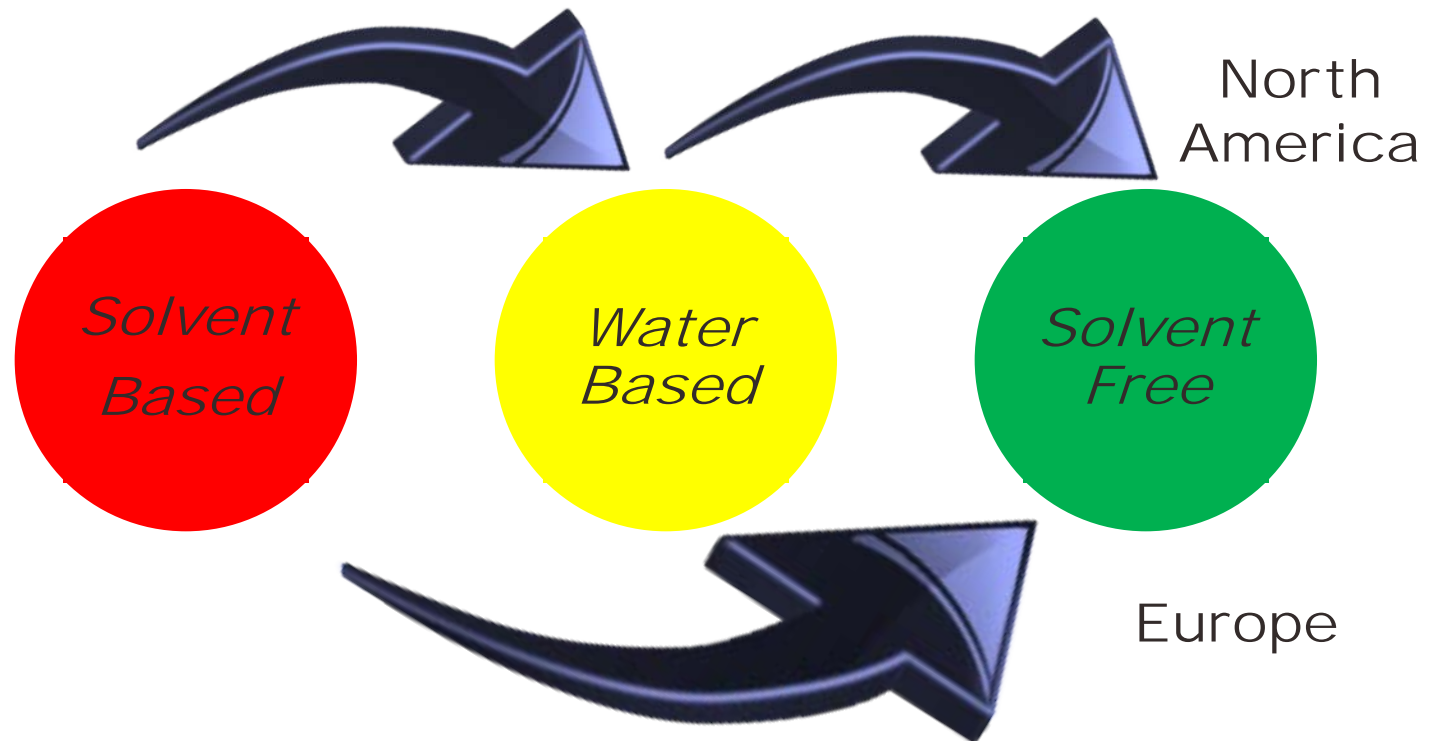


- Renewable
 - Renewable Cellophane
 - PLA
 - Paper
 - Aliphatic-Aromatic Polyesters
 - Bio – Polyethylene
 - PHA
 - Starch Based TPUs
- Traditional
 - Polyester
 - Polypropylene
 - Polyethylene
- Hybrids
 - Combinations of the above

Adhesives Today Enable Sustainable Manufacturing



- Reduction in use of organic solvents
- Reduction in energy requirements
- Increasing speeds
- Waste
 - Start up
 - Package failure



Energy Costs

Adhesives Today can Enable Sustainability for End of Life

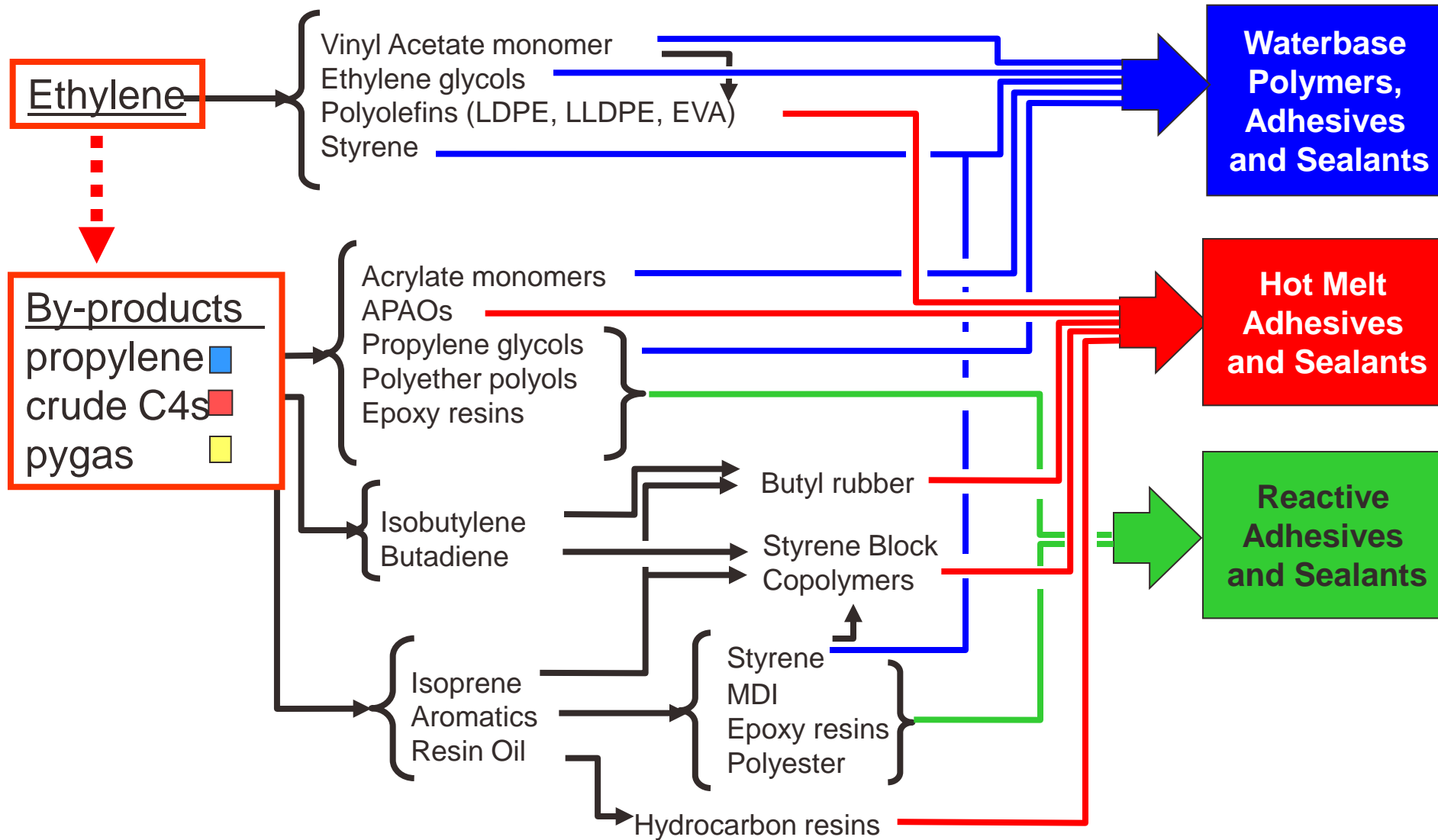


- Certain Products
 - Come from degradable materials
 - Allow composting
 - DIN CERTCO EN13432
 - ASTM D 6400
 - Unique adhesive chemistries allow biodegradable “green” laminations
 - Approved by the market for PLA/PLA, PLASiOx/PLA or PLA/starch modified PE
 - “Green” solution for dedicated end uses
 - Good machinability on Solvent Free laminations
 - Excellent optical clarity
- Adhesives can generally be safely incinerated
 - Typically made from non-hazardous materials
 - Small component of the overall package

Adhesives of the Future

- Move away from synthetic, hydrocarbon content
 - Mindful of lifecycle inventory
 - Realistic scale
 - Maintaining
 - Performance,
 - Price
- Manufactured in increasingly sustainable manner
 - Reduction of energy consumption per pound
 - Reduction of waste in process
 - Reduction in water usage

Ethylene Impacts Key RM Supply



Flextra Quiet™ 1000 Laminating Adhesive

Designed for Sound Reduction

- Renewable and compostable polylactic acid (PLA) and other films are made quieter by laminating with Flextra Quiet™ 1000
- Reduces sound to levels of conventional film laminations

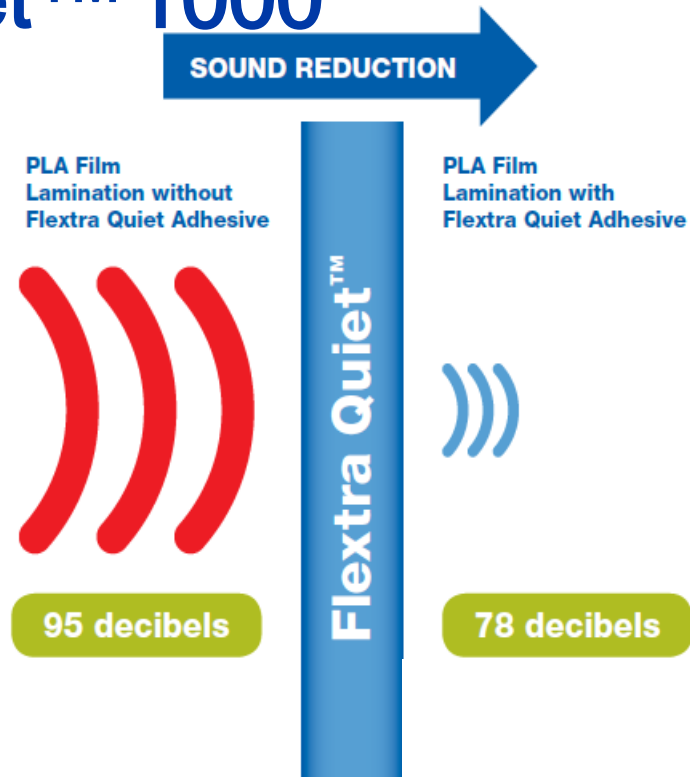
Designed for Many Applications

- Snack food packaging
- Dry goods packaging
- Fresh-cut produce packaging
- High modulus films

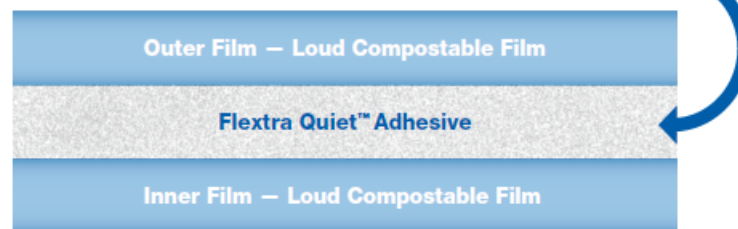
Designed for Performance

- Facilitates use of renewable film
- Excellent for breathable film applications
- Excellent clarity
- Can be easily blended with a co-reactant
- Rapid slit and cure time
- Excellent adhesion to metalized films

Flextra Quiet™ 1000



SOUND DEADENING ADHESIVE



Feature Solventless Product: Flextra® SFA8210 / XR1210 Compostable SF Adhesive

- DinCertco and O.W.S.
- Fragmentation vs. time and ecotoxicity.
- BPI typically accepts DinCertco and O.W.S. testing
- Laminates tested:
 - Unprinted PLA/SFA8210 + XR1210/PLA
 - Printed PLA/SFA 8210 + XR1210//PLA
 - Unprinted PLA/SFA8210 + XR1210//PE starch modified
 - Cellophane coated/SFA8210 + XR1210//cellophane heat sealable coated
 - Starch modified PE//SFA 8210 + XR 1210//Starch modified PE
- Multiple companies tested. All companies passed the fragmentation test.
- Liquid samples submitted for ecotoxicity tests to DinCertco and passed.

In Summary

Adhesives enable renewable flexible packaging

- Advancing key trends in flexible packaging
- Enhancing consumer perception of flexible packaging
- Allowing broader variety of renewable films to be used
- Balancing sustainability and performance
- Opening the doors to 100% sustainable flexible packaging

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