Water-based Compostable Lamination Adhesive

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FlexPackCon 2017, Akbar Hussaini

Water-based Adhesive Lamination Overview

Laminated Film Flexible Packaging

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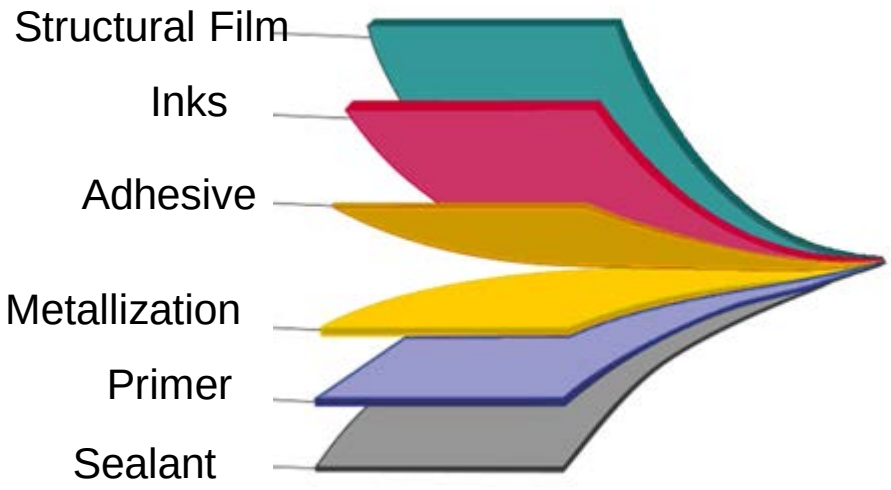
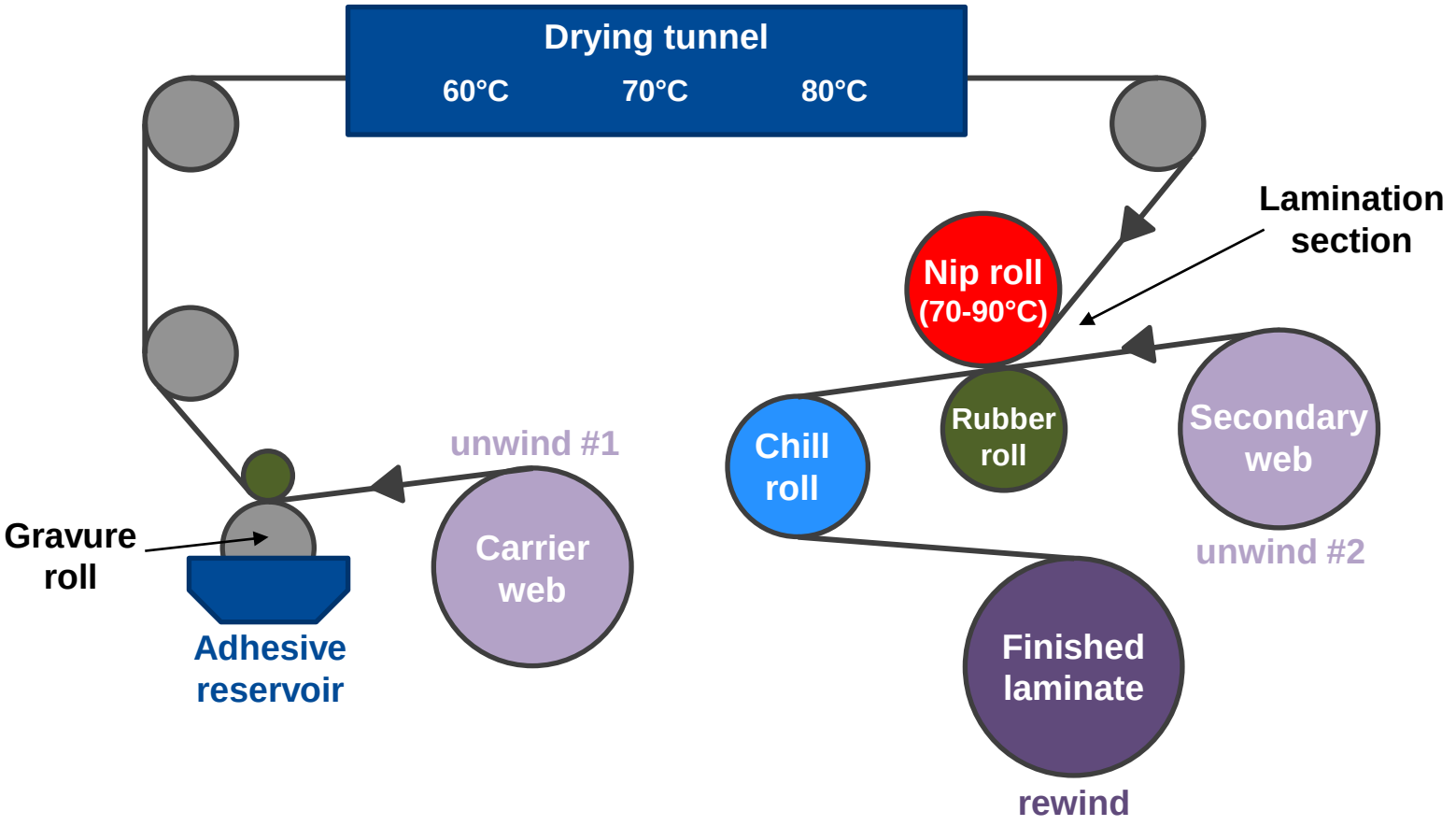
Typical Structure



Water-based Film-to-film Lamination Adhesives

Coater Overview



Water-based Film-to-film Lamination Adhesives

Surface Tension and Film Pretreatment

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- Films must be pretreated to ensure surface tension > 38 dynes/cm
- High surface slip agent levels can cause adhesion issues
- In-line corona treatment is recommended to fresh-up the surface tension
- Insufficient film pretreatment can result in lower bond strength
- Excessive corona treatment can destabilize the emulsion and generate coating defects.

Water-based Film-to-film Lamination Adhesives

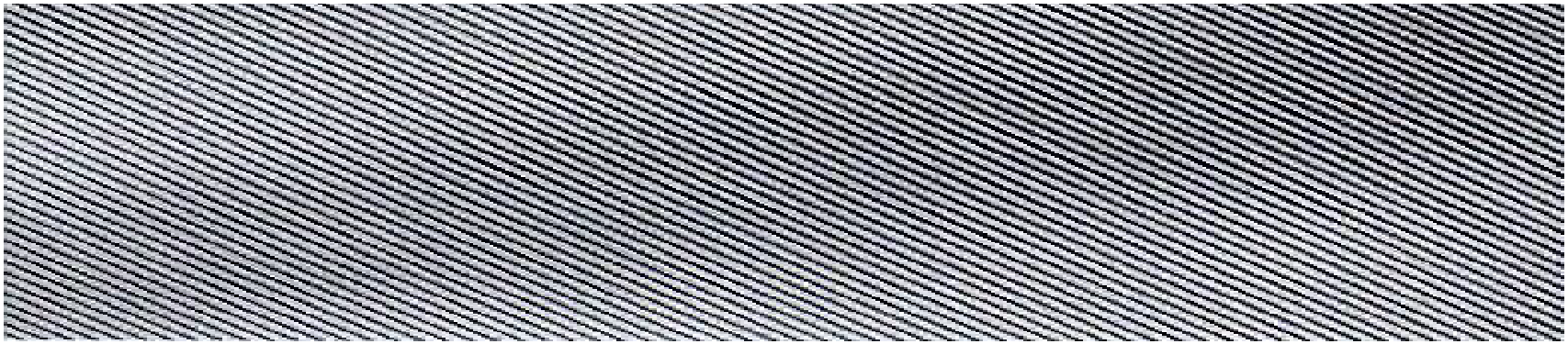
Coating Weight and Application Solids

- Recommended coating weight depends on required performance level and roughness of the film surface
  - for General purpose applications: 2.0 - 2.5 g/m^2 dry
  - for Medium performance: 2.3 - 2.8 g/m^2 dry
  - for Retort applications: 2.5 - 3.2 g/m^2 dry
- For lamination onto paper, coating weight of 3-4 g/m^2 is recommended

Water-based Film-to-film Lamination Adhesives

Coating Cylinder

- Gravure cylinder with line structures are recommended



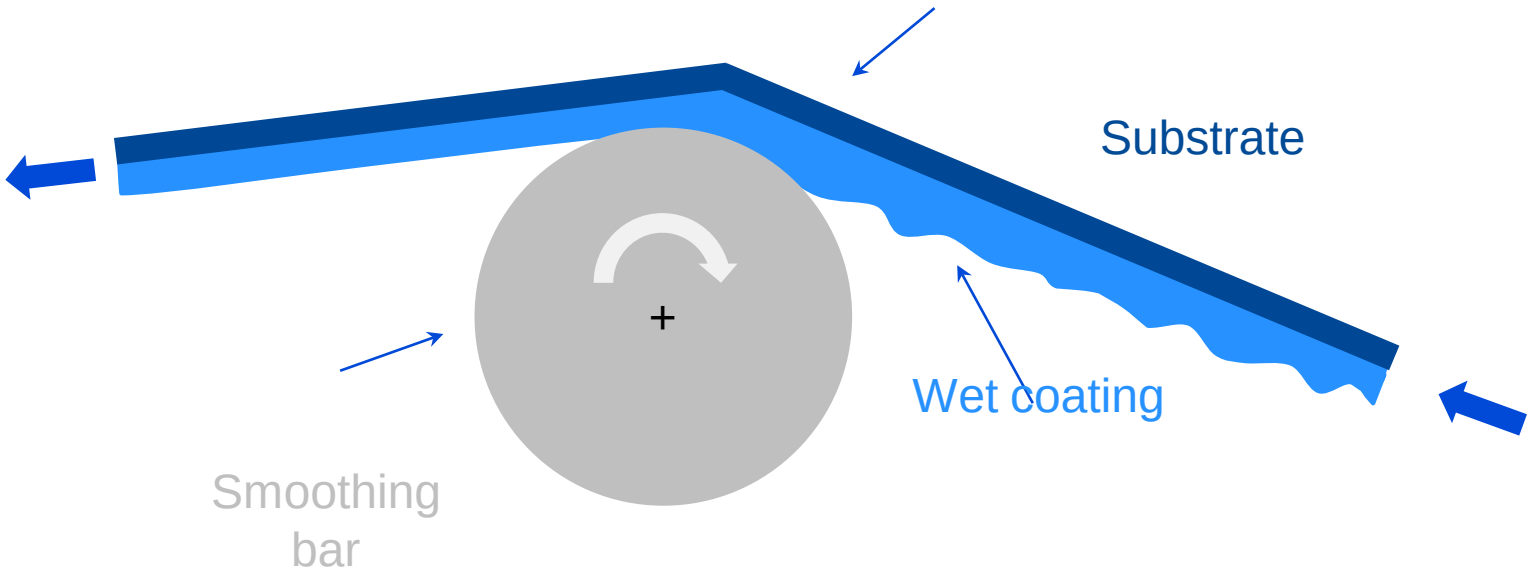
- Recommendations for various coating weights:

Coating weight	Line gravure angle	Lines / cm	Volume
1.9 - 2.3 g/m² dry	45°	80	17 ml/m²
2.3 - 2.8 g/m² dry	45°	50	22 ml/m²
3.5 - 4.0 g/m² dry	45°	44	30 ml/m²

Water-based Film-to-film Lamination Adhesives

Smoothing Bar

- A highly polished roll that can minimize coating patterns and irregularities



Water-based Film-to-film Lamination Adhesives

Smoothing Bar

- A smoothing bar can be helpful, but is not always required
- Smoothing bar improves flow-out of the coated surface before it is laminated to the second substrate
- “Smooth coatings” are easier to dry and result in better appearance of laminates
- How to install?
  - The smoothing bar should be placed as close to the coating unit as possible
  - It should be operated against web direction and have a variable speed control

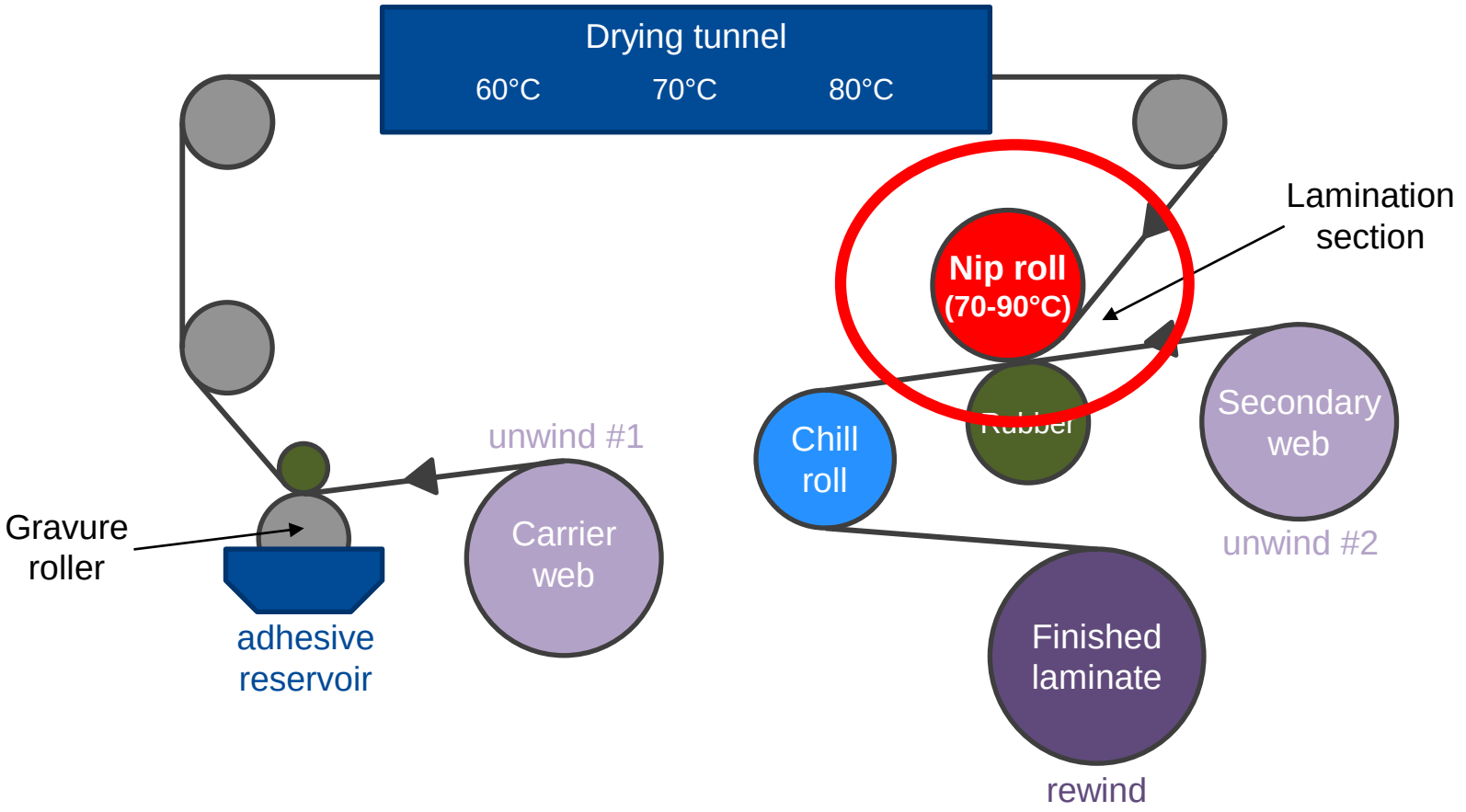
Water-based Film-to-film Lamination Adhesives

Drying

- Very important: use maximum airflow / velocity (typical oven temperatures of 80-90°C)
- When using zoned ovens, use an increasing profile temperature
- Higher temperature in the first zone can lead to skinning of the adhesive and prevent further drying of inner layers
- Try to eliminate recirculation in the ovens by introducing fresh air to maximize its drying power
- Laminations made with poorly dried adhesive will not improve over time
- You must thoroughly dry the adhesive prior to lamination
- The higher the speed of lamination, the higher the oven temperature/ flow of air needs to be

Water-based Film-to-film Lamination Adhesives

Nip Roll



Water-based Film-to-film Lamination Adhesives

Off the Laminator

- The laminate should be clear with good appearance
- Water-based adhesives have a very high shear strength
- Laminates can be slit shortly after lamination
  - Initial bond can be measured, but may not be indicative of capability to slit
  - Slitting capability after lamination should be evaluated for each laminate construction
- Adhesive may exhibit some cold flow; as a result you may see improvement in appearance and bond performance within 24 hours
- Full product and thermal resistance is reached after 3-4 days (depending on laminate construction and Epotal® grade) → then heat sealing is possible

Flexible Packaging Technology Differences

Health & Safety

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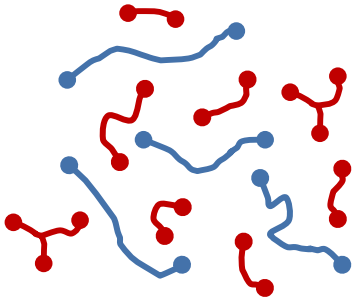
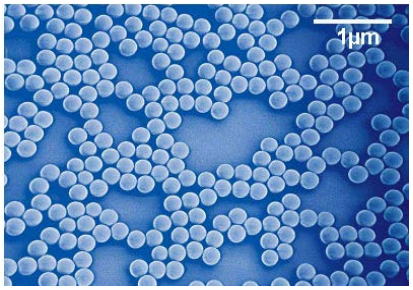
Solvent-based / solvent-free adhesives

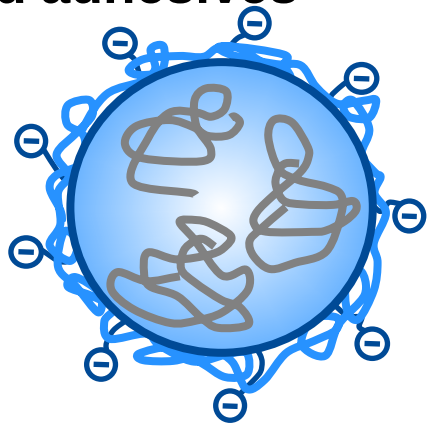


- Low molecular weight components dominating
- Formation of polyurethane network in laminate at converter
- Solution of high molecular weight too viscous

vs.

Water-based adhesives





- Application of high molecular weight polyacrylate / polyurethane
- Adhesive synthesis in chemical reactor
- Low viscosity despite high molecular weight

Water-based adhesive's high molecular weight reduces migration concerns while remaining low in viscosity for easy application

Water-based Solution

Health & Safety

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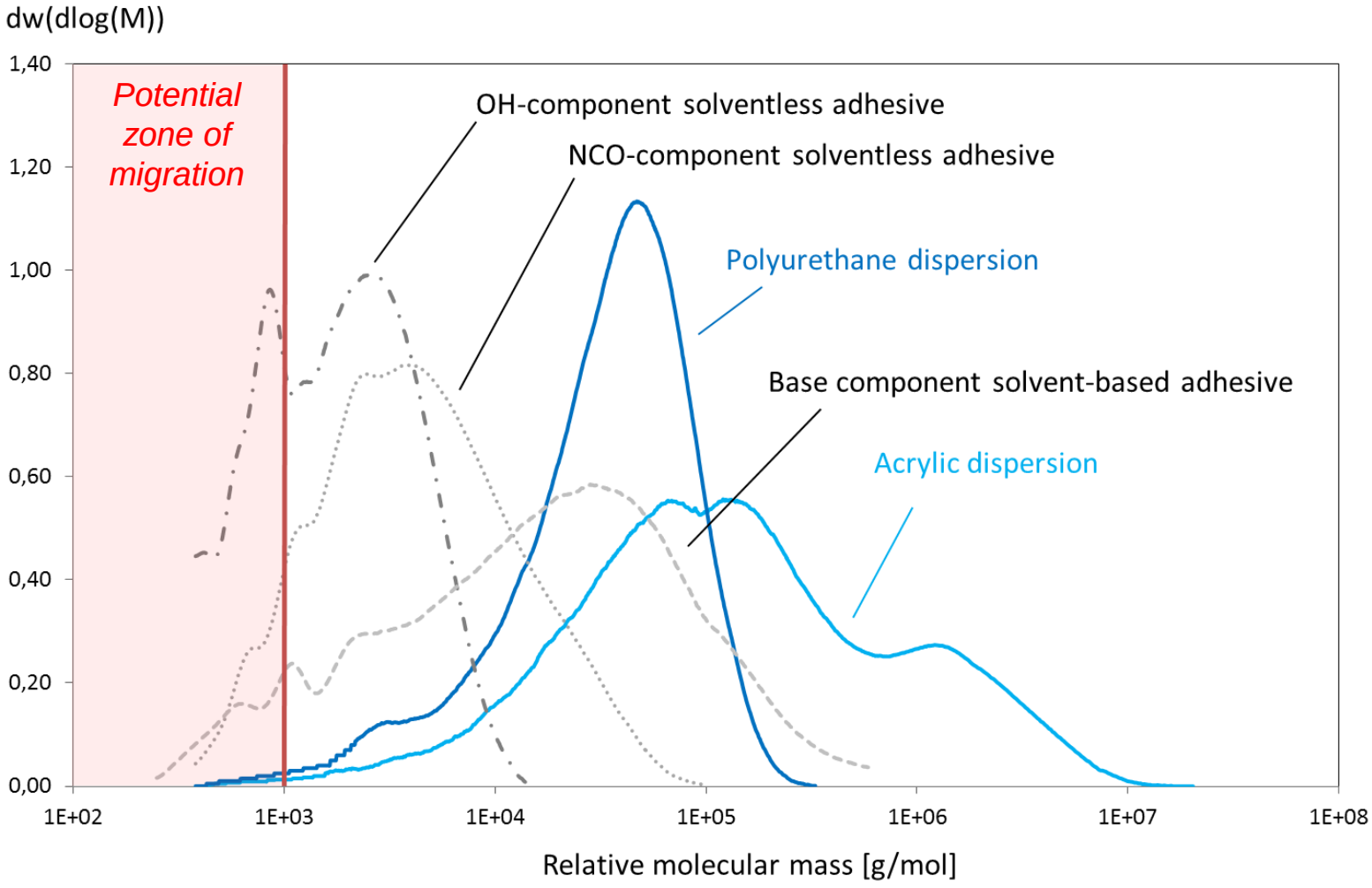
Molecular weight distribution of typical lamination adhesives



Water-based Solution

Performance – Green Strength

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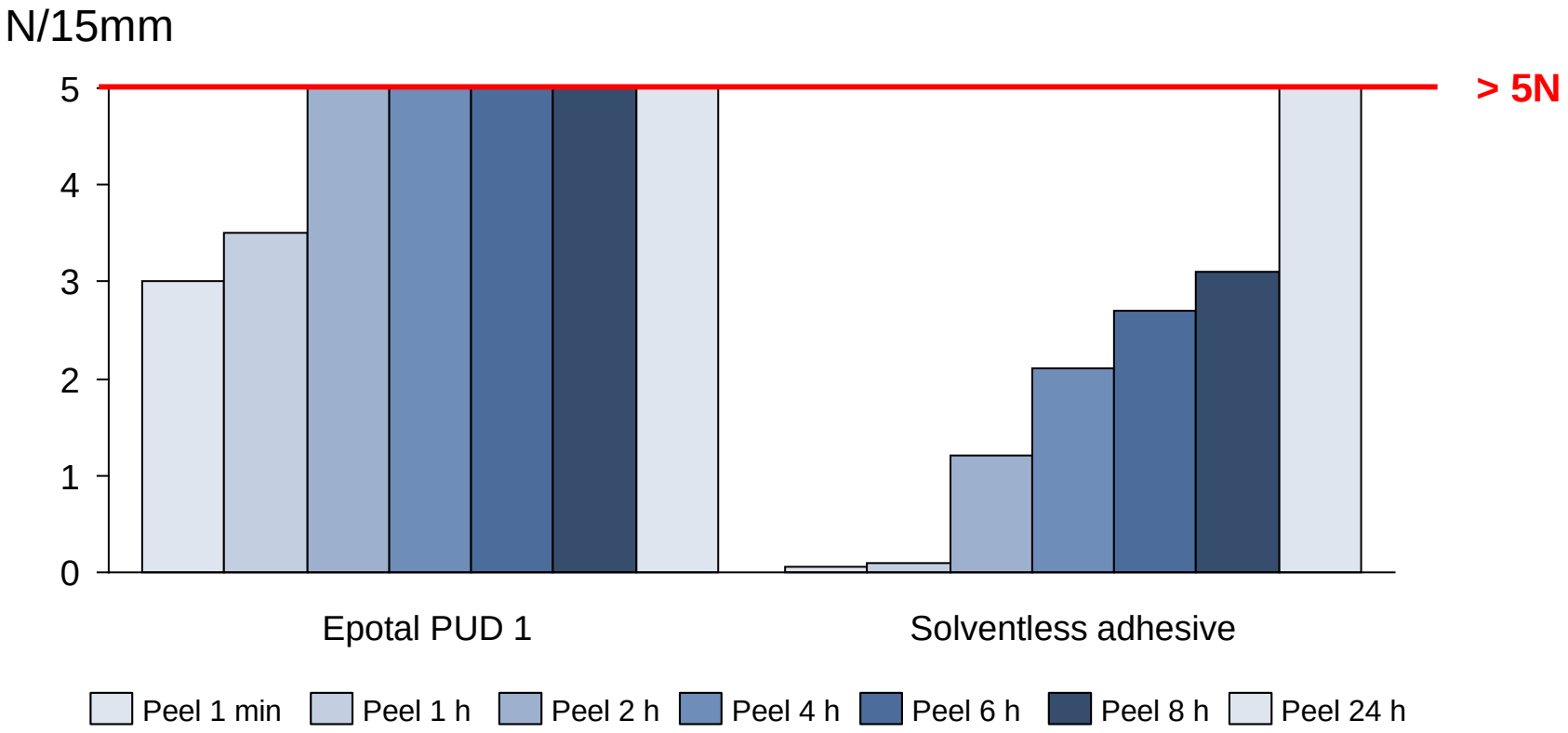
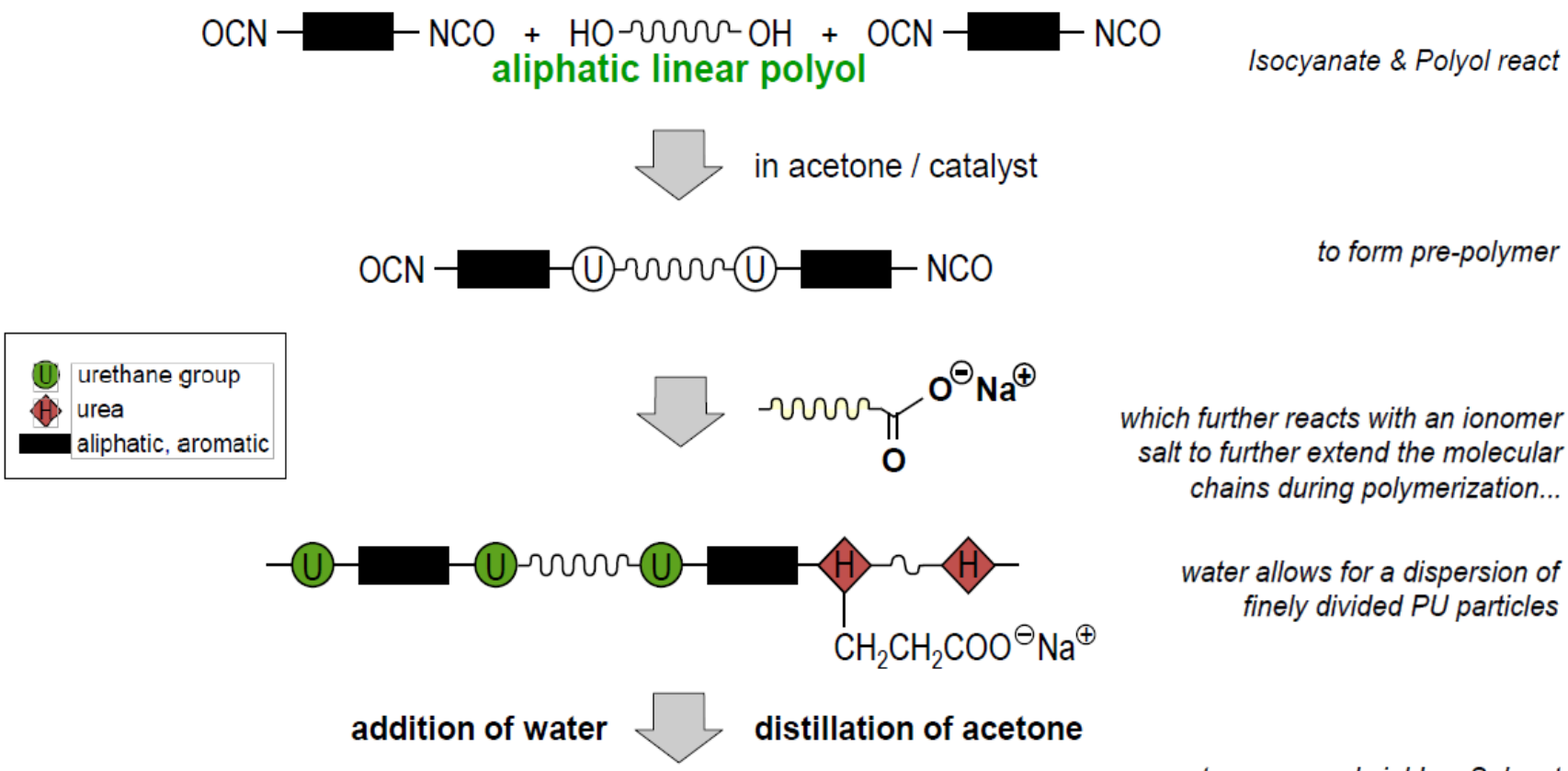
Time dependence of peel strength

(PET-ink/PE, 2.5 g/m²; peel at 300 mm/min; with cross-linker)



Water-based COMPOSTABLE Laminating Adhesives

- An aqueous dispersion of a polyester-polyurethane elastomer



BASF's Medium Performance Portfolio

Epotal® CF 500 w/ Basonat® LR 9056

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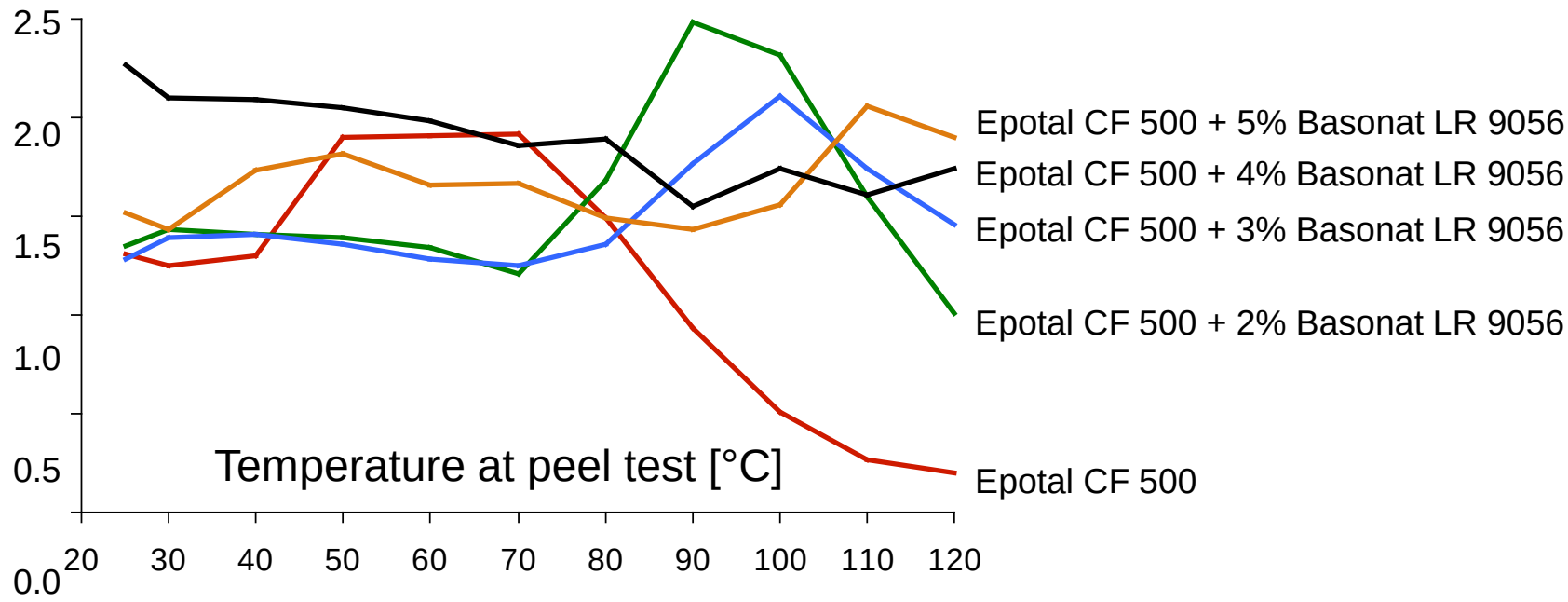
Epotal CF 500

(2,5 g/m²; after 7d, peel at 100 mm/min, PET/OPP)



Basonat LR 9056 can be added when heat stability and chemical resistance are necessary

Polyisocyanate Cross-linkers for Heat Resistance

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	Hydrophilic types			
Basonat®	**HW 100**	**HW 180 PC**	**LR 9056**	**LR 9080***
Solids Content [DIN EN ISO 3251]	100 %	79-81%	100 %	79-81%
NCO (%) [DIN EN ISO 11909]	16,5 – 17,5	13,0 – 14,0	17,5 – 18,5	11,5 – 12,5
Viscosity (mPas, 23°C) [DIN EN ISO 3219]	2000 – 6000	450 - 850	1500 – 3000	500 - 900 (~80%)
Platinum cobalt color (Hazen) [DIN ISO 6271]	< 100		< 40	< 40
Key Properties	Excellent potlife	Excellent potlife, better incorporation	Simplified Incorporation, low foaming	Fast drying, excellent hardness

* Preliminary values

Water Dispersable Polyisocyanate

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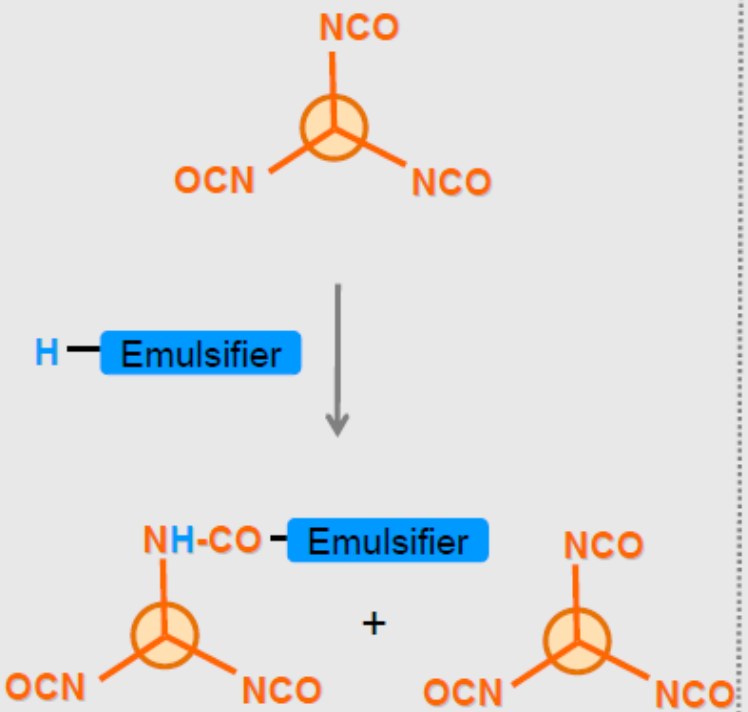
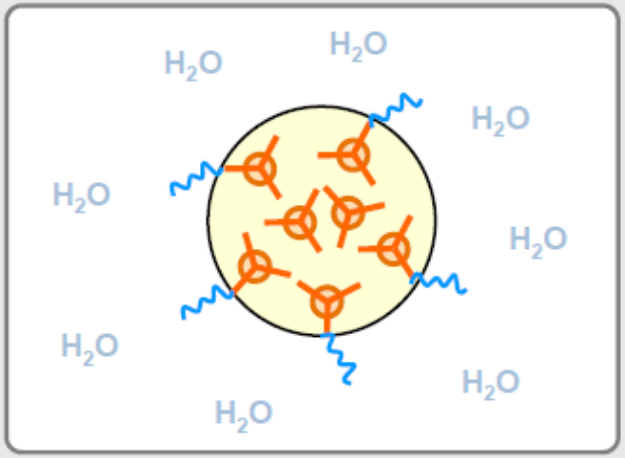
- Technical Solution : PIC modification via reaction with a reactive emulsifier

Chemistry



Dispersibilty

Aqueous system



Emulsifier acts as :
- a surfactant
- a protecting layer

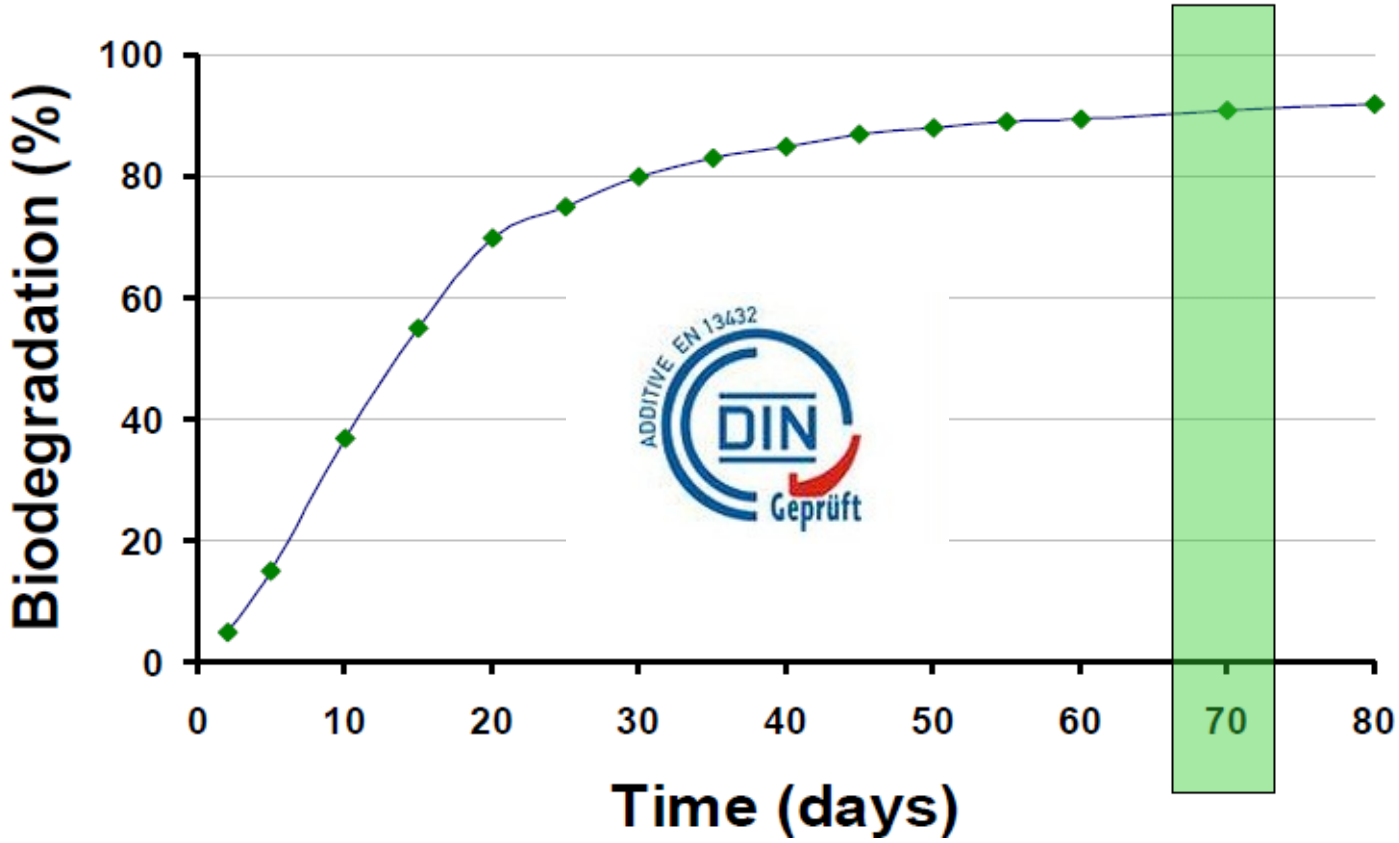
Dispersible via mechanical or hand mixing

„Pot-life“ of several hours

The Key to Compostability, Aliphatic Linear Polyester

- Hydrolysis disintegrates (converts) the aliphatic linear polyester
- Microorganisms (bacteria, fungi) incorporate these fragments
- The temperature in the industrial compost (50-60^{o}C) accelerates this process
- (Tcompost > Tcrystallization)

Proving Compostability – TÜV Rhineland Certification



EN (European norm) 13432: To call a substance “compostable”, it must biodegrade more than 90% within 90 days. Epotal P 100 ECO accomplishes this in just 70 days.

Certifications and Clearances

Epotal ECO 3702 & Epotal P100 ECO

- Regulatory
  - TSCA
    - Released/listed
  - FDA
    - The application rate of the product will be no greater than 0.039 g/in2 (60 gsm).
    - Therefore the product may be used for applications according to 21 FDA CFR §175.105, 175.125, 175.300, 175.320, 176.170 und 176.180.
  - Prop 65
    - Warning
- Compostability
  - DIN-CERTO to DIN EN 13432
    - 8Z0004 Epotal P100 ECO/Basonat LR 9056/Lumiten® I-SC
    - 8Z0004 Epotal 3702 ECO/Basonat LR 9056/Lumiten I-SC
  - BPI to ASTM D 6400
    - Epotal P100 ECO in progress
    - Epotal ECO 3702 in submission

BASF's Certified Compostable Adhesive

Epotal ECO 3702

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Compostable adhesive Epotal ECO 3702

- Provides opportunities to address new markets
- Contributes to sustainability policy
- First certified compostable water-based laminating adhesive
- Substrates include all different types of degradable films,
  e.g., ecovio®, ecoflex®, PLA, paper, metalized films, cellulosics, starch-based films

Thank You

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