Sustainable Coatings for Medical Textiles

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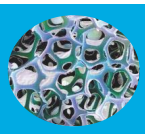
Agenda / Content

- **Market Needs of Coatings for Medical Textiles**
- **Polyurethane Dispersions**
  - Material properties
  - Film properties and blending
  - Application example: Coating of bed linen for incontinence
- **Polyurethanes for Cohesive Bandages**
  - Market Needs
  - PUD "C"– a new material for the bandage market
  - The application triangle

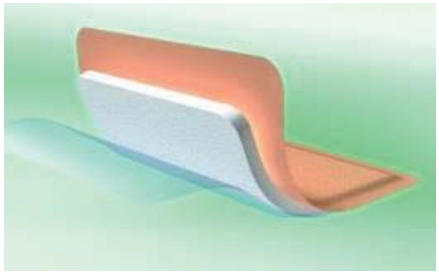
Covestro – formerly Bayer MaterialScience

Otto Bayer (Bayer AG-Covestro) invented polyurethane in 1937.
Covestro has over 80 years of polyurethane (PU) experience.

covestro

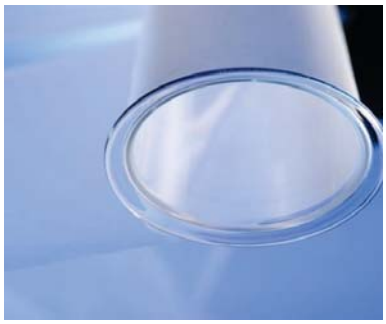
Polyurethanes	Polycarbonates	CAS
 Raw materials for rigid & flexible foams	 Granules & sheets	Raw materials for Coatings, Adhesives & Specialties **Baymedix** Films & Raw materials for Medical

Applications in medical



- Coating for medical textiles
- Bandages/ Compression therapy
- Sealants for medical devices
- Dipped articles, hospital disposables

Market Needs



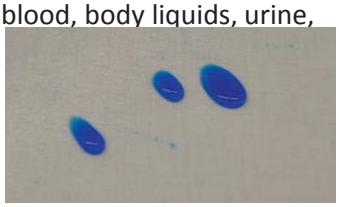
Coatings for Medical Textiles

- Textile touch and chemical stability
- Excellent mechanical properties
- Sustainable Technology
- Ensures safe working environment
- Secure and high quality material supply

Market Needs for Medical Textiles

Textile touch (sensory impact) and chemical stability

- Medical textiles often need coating for protection from blood, body liquids, urine, disinfectants and other chemical products.
- Washing and cleaning is often a challenge.
- The textiles shall still keep their dry feel and shall not wrinkle or create rustling.



Droplet test on coated linen

Mechanical strength

- Coating shall follow elongation/ stretching of textile and shall not break.

Safe and Sustainable technology

- Materials for healthcare/medical require qualification and EQM* system
- Trend to reduce hazardous materials, exposure risk, and waste products
- More stringent regulations will further drive safety and cost advantageous of sustainable solutions.

*EQM- enhanced quality management

Challenge of DMF & potential solution

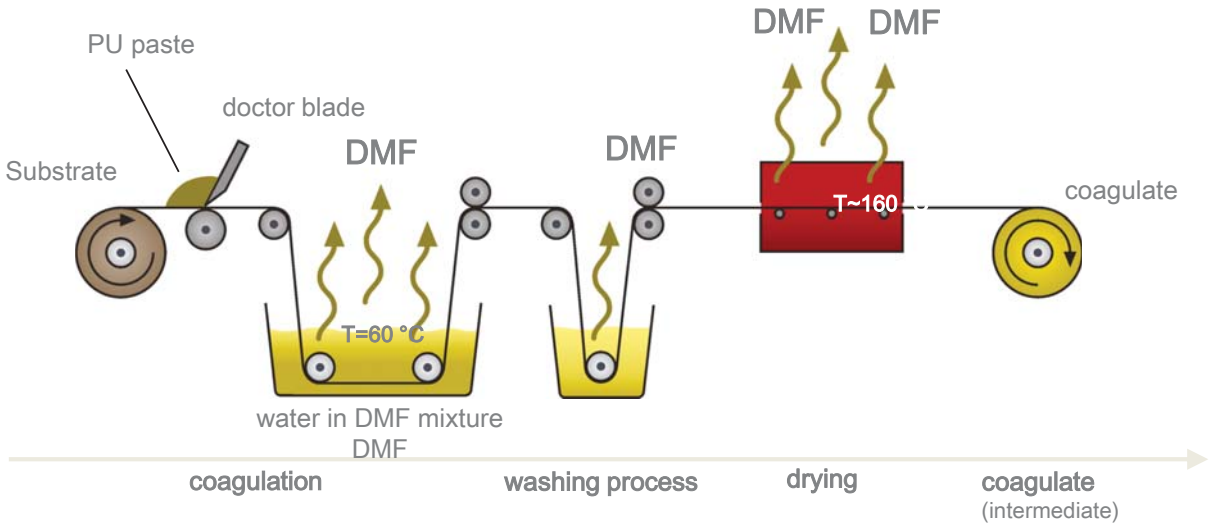
Waterborne dispersions – A sustainable technology

Gold Standard technology: solvent-cast PU films from N,N-Dimethylformamid (DMF)

- N,N-Dimethylformamid (DMF) is a polar, hydrophilic aprotic solvent with a high boiling point
- DMF is amongst others used in the production of medical devices
- DMF is classified as SVHC (Substance of Very High Concern) and CMR substance (**C**arcinogenic, **M**utagenic and toxic to **R**eproduction)
- DMF is the most suitable solvent for polyurethane in solvent-casted films.
- There is no real alternative solvent of less toxic potential

DMF* emitted into air and water

Brings exposure & pollution risk

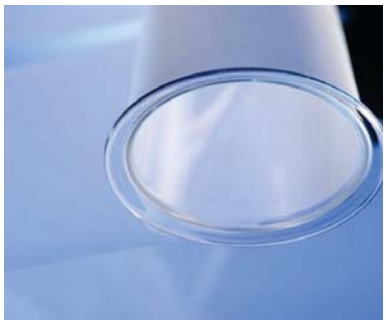


Restrictions on DMF use will present the industry with challenges to find qualified alternatives.

Water-based dispersions offer a solution!

Polyurethane Dispersions

- Raw material and film properties
- Crosslinking of PU-films
- Processing



Higher solid content PUD

Aqueous polyurethane dispersion – base material

Composition of Polyurethane Dispersion:

- Fully reacted polymer dispersed in water

HiSolid PUD	Properties
Solid content	57 - 62 wt.%
Water content	38 - 43 wt.%
Solvent	no
Viscosity	< 2,000 mPa•s

Allows for:

- Basic dispersion for textile coatings
- High solid content
- Cross-linkable for high chemical stability

Lower solid content PUD's for customization

Dispersions for tailoring mechanical properties – blend material

Tailoring mechancial properties:

- Water-based dispersions are fully miscible at any ratio.
- High elongation and excellent soft touch.
- Solution C allows cross-linkability.

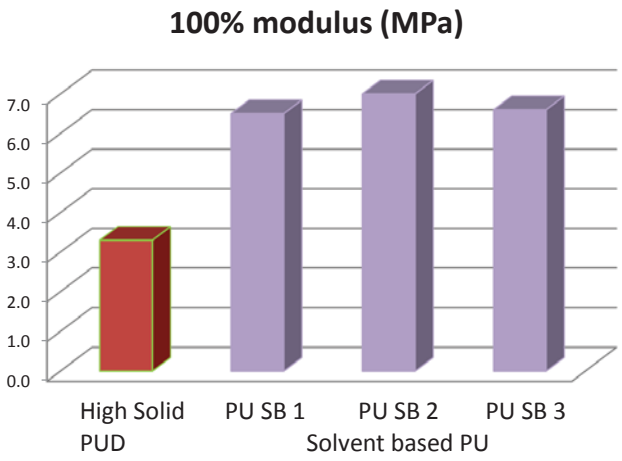
Specifications of PUD grades	A	B	C
Solid Content [%] (DIN EN ISO 3251)	39 - 41	39 - 41	48 - 52
Efflux time at 23°C, 4 mm cup [s] (AFAM 2008/10503)	max. 70	14 - 40	*
pH (DIN ISO 976)	6 - 8	5.5 - 7.5	6 - 9

*: Viscosity at 23°C: 50 - 1,000 mPas (ISO3219/A.3)

High Solid Content PUD– Soft Touch Film

Competitive testing shows excellent mechanics and flexibility

Low friction – Stretchabiliy – Natural feeling



- 100% modulus relates to force needed for short elongation.
- The lower the 100% modulus, the softer the film feeling.
- ***Therefore, low 100% modulus is indication for better soft touch!***

HiSolid PUD Film Properties

Flexible, soft touch, breathable film

Film characteristics:

- Soft touch
- Flexible and elastic
- Excellent mechanical stability
- Breathable

Different PU dispersions are available to match film performance

- Blend with “B“ to enhance rigidity.
- Blend with “A“ and/ or “C“ for more softness and elongation.
- Mix with cross-linker to increase chemical resistance.

Polyurethane - Film Properties

Choose a combination to tailor mechanical properties

Properties of film made from waterborne PUDs (Thickness of film)	HiSolid film	A (70 µm)	B (50 µm)	C (40 µm)
100% modulus [MPa] (DIN EN ISO 527-2)	~ 3.3	1.6	5.8	~ 0.3
Tensile strength [MPa] (DIN EN ISO 527-2)	40 ~ 42	18	35	5
Elongation at break [%] (DIN EN ISO 527-2)	550	1,100	700	> 2,000
MVTR [g/(24h•m²)] (related to DIN EN 13726-2, Part 3.2)	2,100 (25 µm)	1,800	1,400	1,600 (80 µm)
Major performance aspect (blending or mixing)		Very flexible Soft touch	Higher rigidity	Very soft Cross-linkable

* Drying conditions: 37°C, 10 min. followed by 120°C, 2 min., 50 µm

HiSolid PUD with cross-linder

Enhanced chemical stability using cross-linker

Cross-linker properties:

- Hydrophilic, solvent-free
- Ease of processing (pot life ~ 8 hrs)
- High chemical stability of HiSolid film with cross-linker
- Recommended ratio: ~ 5 wt.-%

Property	Cross-linker	Method
NCO content	~ 17.4 %	M105-ISO 11909
Viscosity at 23°C	~ 2,800 mPa•s	M014-ISO 3219/A.3
Monomer content	< 0.15 %	M106-ISO 10283

Film made with HiSolid PUD and cross-linker:

Comparison of standard and cross-linked film made of HiSolid PUD after several weeks incubation in disinfectant solution

Standard film Cross-linked film
(Standard film dissolved and therefore not visible)

HiSolid PUD Processing

Easy manufacturing of film by coating process

Rollstock coating:

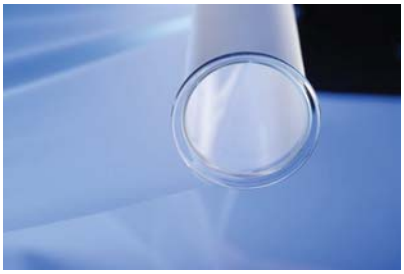
Manufacturing:

- Easy application, 1K polyurethane dispersion
- Waterborne, physical drying only
- Direct or transfer coating on foams, nonwovens, textiles
- Recommended to use non-siliconized release liners
- Drying (lab procedure): 10 min. @ 37 °C, followed by 3 min. @ 150 °C
- Machine process: optional curing at ≥130 °C, approx. 3 min recommended for better film forming

Why Polyurethane Dispersions?

Tailored sustainable technology for cast films

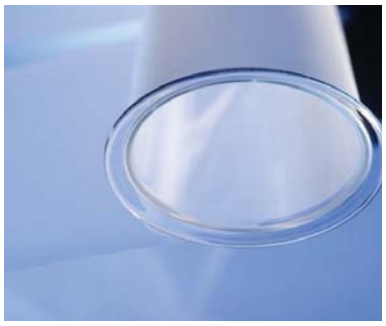
Competitive advantages:

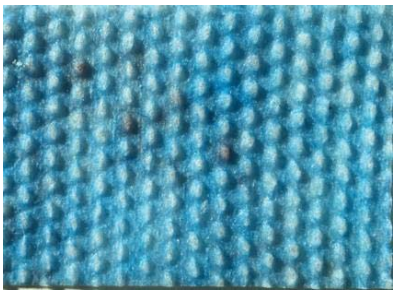


- Aqueous dispersion ensures safe working environment
- Sustainable technology
- Hydrophilic and breathable
- Cross-linking for solvent and disinfectant resistance
- Soft touch films with excellent mechanical stability and flexibility
- Easy to functionalize (dyes, matting agent, etc.), partners for formulation development available.

Application Example

Coating of bed linen for incontinence patients





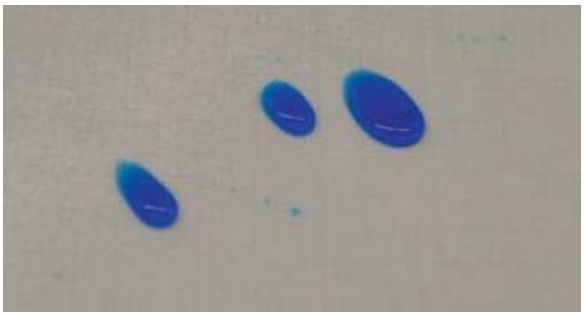
HiSolid PUD Application Example

Coating of bed linen or mattress cover for incontinence patients

Task to be solved:

Functionalized cotton damask fabric with the following requirement profile:

- Waterproof
- Chemical proof
- Textile haptics
- No or low rustling
- Mechanical stability



Droplet test on coated linen

HiSolid PUD Application Example

Coating of bed linen or mattress cover for incontinence patients

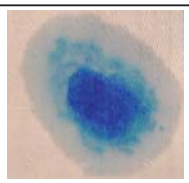
Solution:

Functionalized coating of HiSolid PUD and cross-linker:

- Applicable in knife-over-roll coating and rotary screen printing
- Wet thickness 200 µm, no cut-through

Result:

- Soft, transparent, water-proof coating with with no micro scratches.
- No colour change.
- Coated linen passed 20 times industrial laundry (hopsital) @ 75 °C using chlorinated detergent, each followed by 60°C tumbler without wrinkling or loss of soft touch.



TEGEWA Droplet test on uncoated linen

TEGEWA Droplet test on HiSolid waterborne PUD coated linen

HiSolid PUD –Further Examples

Prototype Samples on Display

Protective Clothing for emergency medical services:

- Barrier-tight
- Stable vs. disinfectants.

Non-woven anti-slip barrier:

- Fabric for e.g. surgical sheets
- Structured surface coating.

Hygienic orthopedic material:

- High elasticity
- Stable vs. disinfectants.
- Potential wound contact.

Drape and gown material:

- Barrier-tight
- Suitable for both, woven fabrics and non-wovens.

Waterborne PU for Cohesive Bandages

Polyurethane-based, Latex-free
Contact Adhesive Dispersion

Market Needs for Cohesive Bandages

Application of cohesive bandages

- Compression therapy, sports bandages, wound care (secondary dressings).

Differentiation

- No new material development since multiple years.
- PU offers unique advantages such as white, non-yellowing, low odor.

Non-allergic

- Current market products are subject to latex allergies.

Sustainable technology

- Covestro offers water-based polyurethane dispersions.
- Covestro medical grades have been tested and qualified for medical use.

Why waterborne PU– Safe Technology

Non-allergenic and Latex-free

Latex allergies:

- Approx. 2% of the total population suffer from natural latex sensitization
- Employees in the medical area are affected by 10% to 17% (e.g. gloves)
- This is a matter of either a type 4 contact hypersensitivity causing post reactions on the contained additives in latex-products or type 1 hyper-sensitivity caused by different water soluble proteins in natural latex
- Due to the fact that the allergens are known and avoided during manufacturing the occurrence of type 4 hypersensitivity is decreasing
- In contrast the type 1 hypersensitivity increased over the last years

Allergic reactions can have severe consequences, therefore the market demands alternatives

Source: http://www.daab.de/allergien/latexallergie/

Waterborne PUD for Cohesive Bandage

PUD "C"

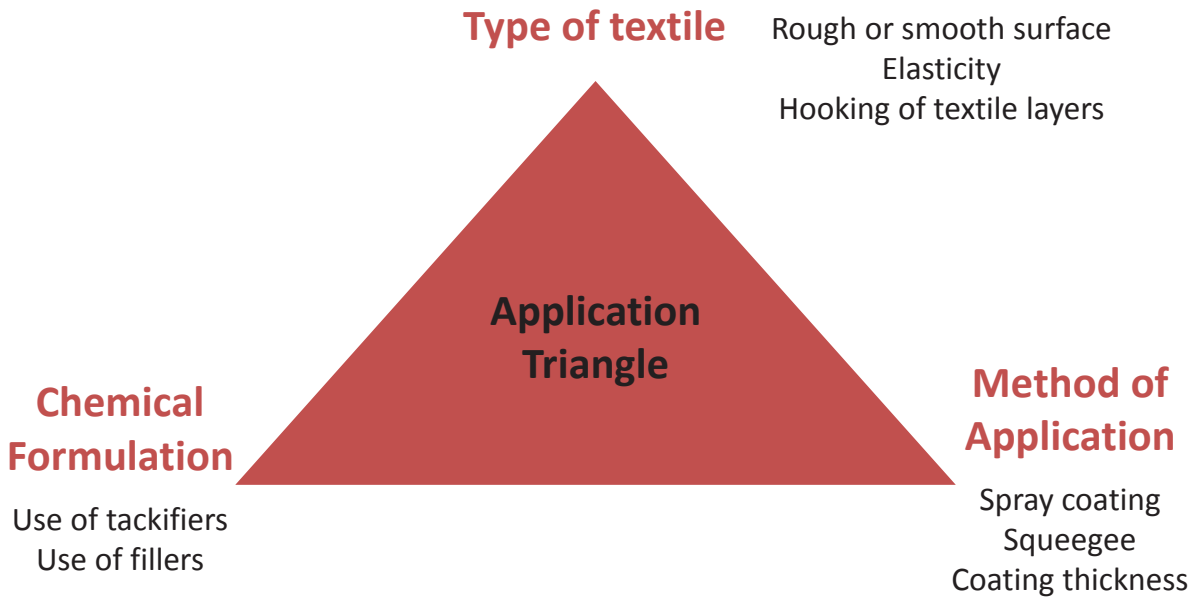
Composition of Polyurethane Dispersion:

- Fully reacted aliphatic polyurethane polymer dispersed in water.
- Latex-free, chlorine-free, white.

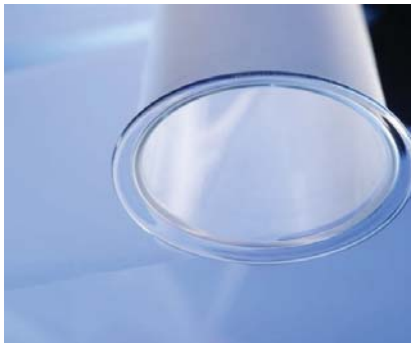
Prov. Specification	C
Solid Content [%] (DIN EN ISO 3251)	48 - 52
Viscosity at 23°C (shear rate 40s^{-1}) [mPas] (M014-ISO 3219/A.3)	50 - 1,000
pH (DIN ISO 976)	6 - 9

PUD "C"– The Magic Triangle

Tailoring of Textile, Formulation and Application Method



Summary



Summary

Sustainable polyurethane coatings for medical textiles and bandages

- High quality and longer use time are key requirements of new medical textiles.
- Non-allergenic and solvent free medical textiles are getting more and more importance.
- Water based PU-dispersions serve all those needs and offer sustainable and long term taylor made solutions.
- Especially developed Baymedix dispersions can be blended to achieve high elasticity, chemical resistance, soft touch and other features.
- Waterproof and stable coating of bed linen with textile haptic for incontinence, or water based coatings for cohesive bandages which stay white and have low odor, are examples for this new sustainable polyurethane technology.

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Questions?

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