

New Coating Technologies, Part 1

Polyurea Spray Elastomers

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What is Polyurea?

“Polyurea” is a description of a technology and it in itself is not a coating / lining material.

Not all polyurea systems are the same!

Polyurea Technology

- A **pure polyurea** coating / elastomer is derived from the reaction product of a polyisocyanate component and an amine-terminated resin blend.

For reference purposes, a **polyurethane / polyurea hybrid coating / elastomer** is the reaction product of a polyisocyanate component and a resin blend component. The resin blend may be made up of blends of amine-terminated and / or hydroxyl-terminated polymer resins.

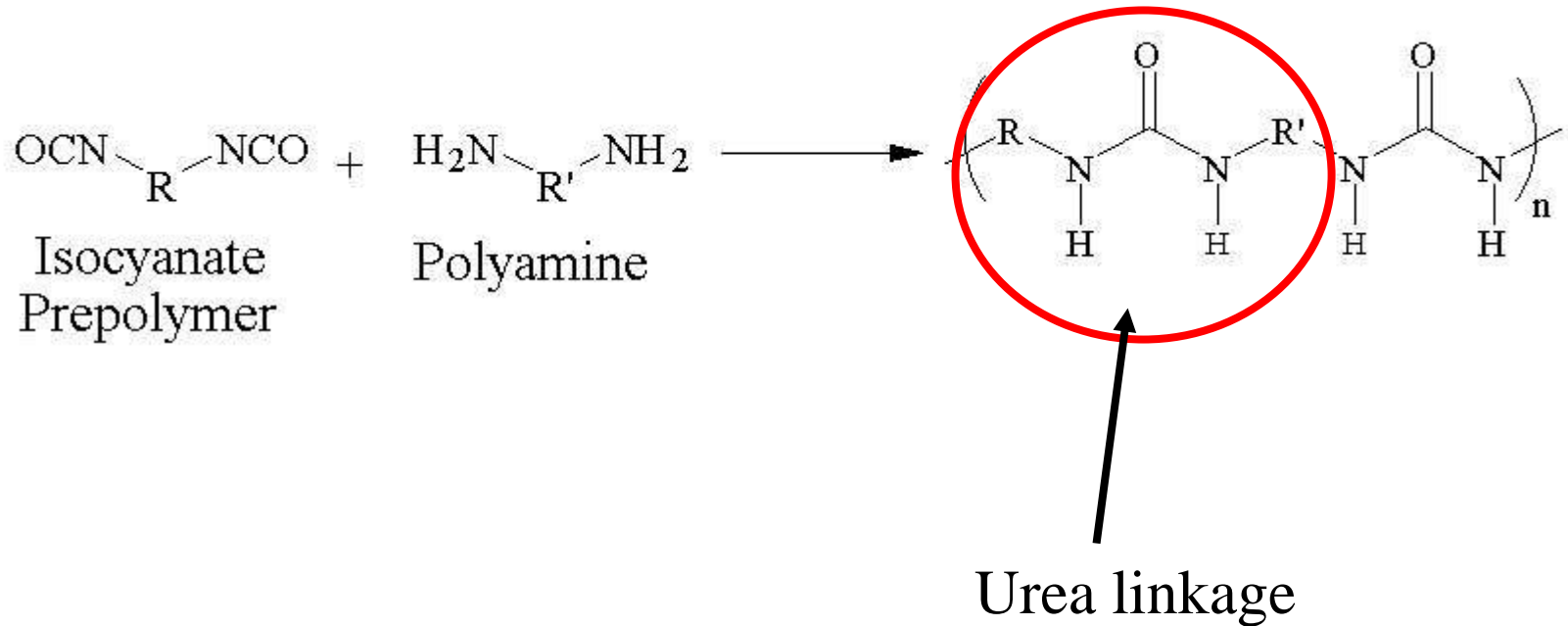
As per the Polyurea Development Association

Polyurea Technology

From the PDA Definition:

- Two-part system
- One part is Isocyanate component
 - reactive isocyanate groups (-NCO)
- Other part is a Resin blend component
 - reactive group is amine (primary or secondary)
 - (-NH₂ or -NH-)
- Reaction of the two components yields a urea linkage

Polyurea Technology



Polyurea Spray Technology - History

- **1986 - 1988**

- Polyurea spray technology developed / marketed
- Primary use as coating over spray polyurethane foam

- **1995**

- First commercial use in Nuclear Applications

Polyurea Spray Practical Advantages

- Fast set / cure: minimal downtime
- Extended working season
- Flexible: bridges cracks
- Resistant to many chemicals
- Seamless & Waterproof
- No solvents, No VOC's, No odor
- Easily decontaminated / high polymer surface molecular weight (US Patent 5,763,734)

Typical Physical Properties

Tensile strength, psi	up to 6500
Shore Hardness	A 30 to D 65
Elongation, %	up to 1000
Tear strength, pli	250 to 600
100% Modulus, psi	500 to 2000
Burst strength, psi	250 to 500
Flex/Crack Bridging	> 1/8 inch
-26 °C / -15 °F	

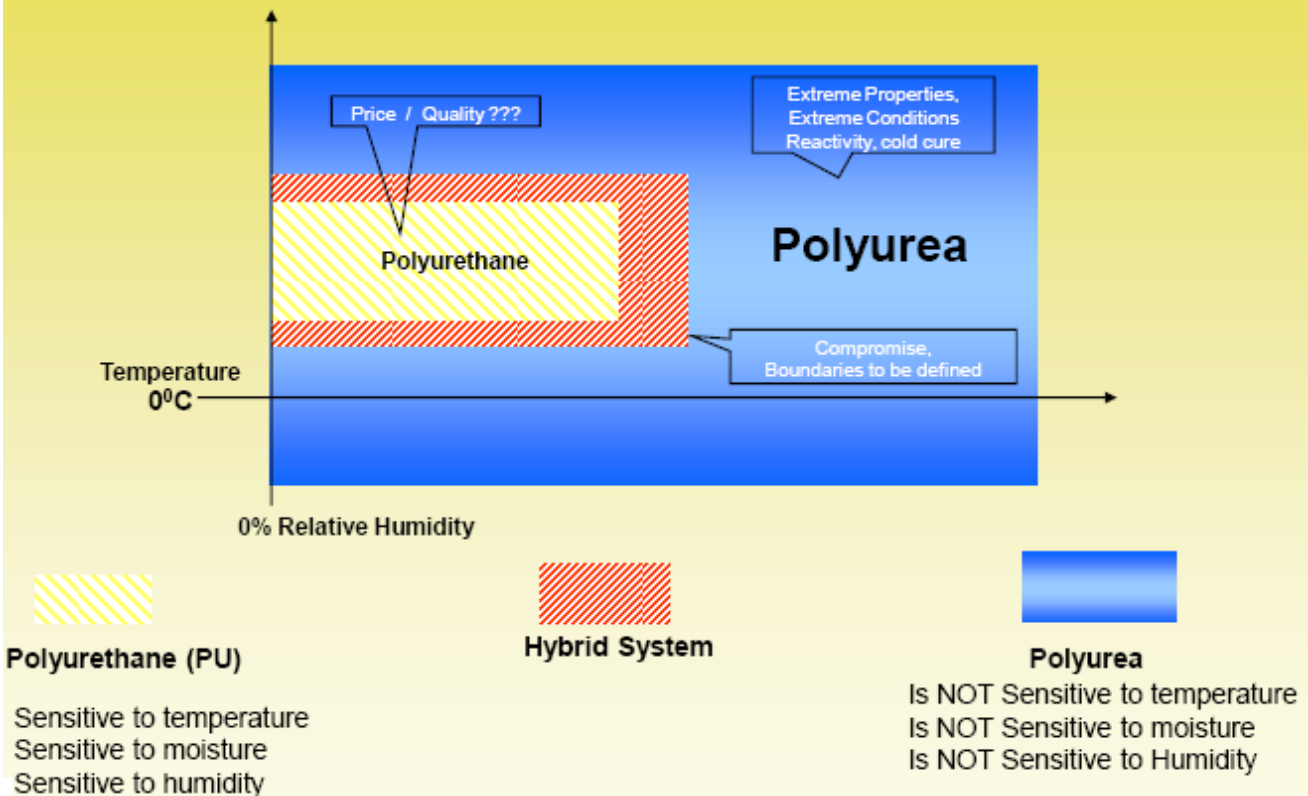
Performance Characteristics

Performance Type	Polyurea	Polyurethane	Polyester	Epoxy
Physical Strength	Low-High	Low-Mid	High	High
Elongation	High	Low-High	Low	Low
Abrasion Resistance	High	Mid-High	Mid-High	High
Adhesion to Concrete	High	Low-Mid	Mid	High
Cure Shrinkage	Low	Low	High	High
Impact Resistance	High	Mid	Low	Low
Permeability	Low	Mid-High	Low	Low-High
UV Resistance	High	Low-High	Mid-High	Low
Temperature Limit	High	Mid	Low-Mid	Low

Performance Characteristics

Qualification Process

Why Polyurea over Polyurethane ?



Performance Characteristics

Irradiation Exposure information*:

Gamma Dose (Mrad)	0	5.0	10.0	49.97	100.00	200.0
Distance form source, cm	--	5.0	5.0	5.0	5.0	5.0
Gamma Dose rate, rad/hr	--	534289	534289	533904	533428	532410
Irraditation time, hr	--	9.367	18.717	93.60	187.467	375.65
Interrupt time, min	--	0	7	59	2114	3822

Elastomer Properties:

Tensile strength, psi (ASTM D 638)	2300	2140	2195	2085	1790	1520
Elongation, % (ASTM D 638)	155	140	145	135	90	15
Shore D Hardness (ASTM D 2240)	56	58	58	54	55	56

* Cobalt-60 source

Nuclear irradiation exposure work was done at the Ford Nuclear Reactor, The University of Michigan. Dose rates were measured with a Reuter-Stokes ion chamber, Model RS-C4-1606-207. (1995)

Gondola Rail Car Lining

• US Department of Energy

- Fluor Daniel / Boston Transit
- Transfer of low level nuclear waste
- 1999



Concrete Coatings

- **De-Con Work**

Flooring in nuclear application areas, Rocky Flats, CO



Concrete Coatings

- **Savannah River Site, SC**
 - for recovery of radiological contaminated areas
 - 2000 to present



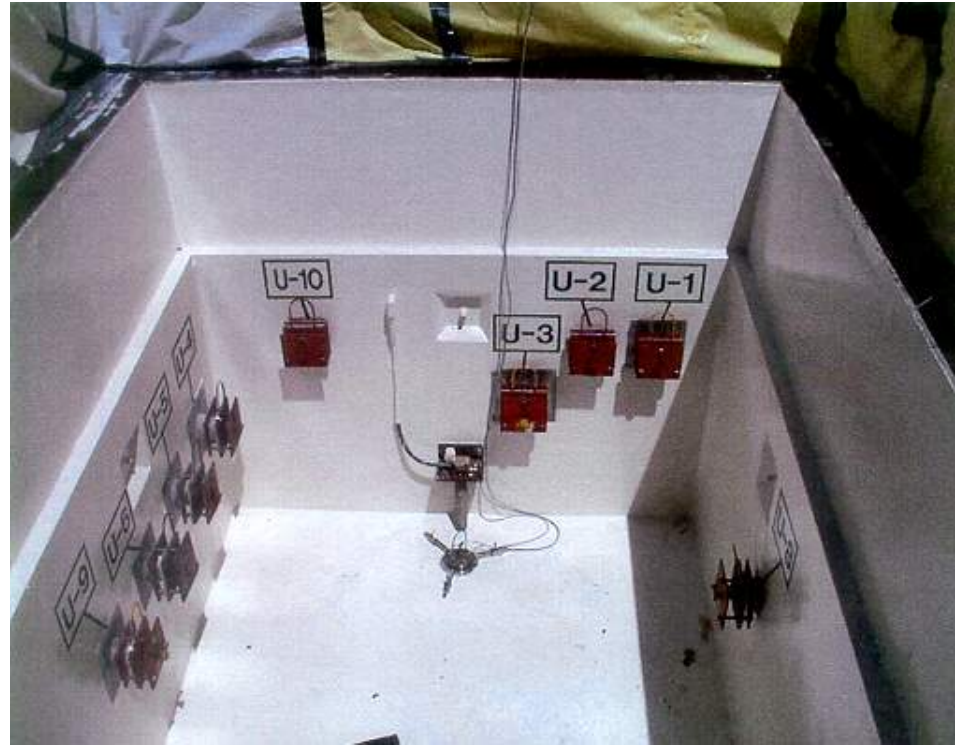
Concrete Coatings

- **CH₂M Hill Hanford**

W-314 pit lining for ease of decontamination of low level radioactive waste, 2001.



Epoxy lined



Polyurea Lined

Concrete Coatings

- **Detroit Edison / Fermi 2**
 - Water Inlet Room, Marley Class Cooling Tower
 - 250,000 gals/min inlet flow,
 - Replaced stainless plates
 - 2004 in service



Shipping Package / Encapsulation

- **Rocky Flats, CO**
 - Encapsulation of contaminated equipment for shipment / burial
 - 2000 - present



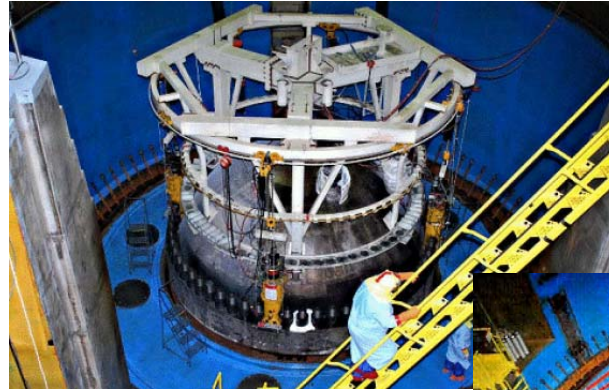
Geotextile Coatings

- **Contaminated Ground Umbrella / Cap**
 - CH₂M Hill Hanford, underground leakage
 - 70,000 ft²
 - Completed 2008



Tank / Linings

- **Reactor Cavity**
 - Oyster Creek
 - Completed 2010



- **Encapsulation**
 - Oak Ridge Nuclear Labs
 - Completed 2010



Tank / Pipe Linings

- **Spent Fuel Pool Linings**
 - NextEra Energy Seabrook, LLC,
Seabrook, NH
 - Completed 2010
- **Cooling tower**
 - inlet and effluent pipelines