Polyurea Development Association

What's a Polyurea Contractor to Do?

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EU Roundtable

Polyurea Technology

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

Polyurea Definition

- **A polyurea coating / elastomer is that derived from the reaction product of an isocyanate component and a resin blend component. The isocyanate can be aromatic or aliphatic in nature. It can be monomer, polymer, or any variant reaction of isocyanates, quasi-prepolymer or a prepolymer. The prepolymer, or quasi-prepolymer, can be made of an amine-terminated polymer resin, or a hydroxyl-terminated polymer resin.**

- **The resin blend must be made up of amine-terminated polymer resins, and/or amine-terminated chain extenders. The amine-terminated polymer resins will not have any intentional hydroxyl moieties. Any hydroxyls are the result of incomplete conversion to the amine-terminated polymer resins. The resin blend may also contain additives, or non-primary components. These additives may contain hydroxyls, such as pre-dispersed pigments in a polyol carrier. Normally, the resin blend will not contain a catalyst(s).**

As per the Polyurea Development Association, 2000

Polyurea Definition

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)
  - ($-NH_2$ or -NH-), no hydroxyls (-OH)
- Reaction of the two components yields a urea linkage

Polyurea Definition

Other reactions for "urea" formation:

- Moisture cured urethane systems (low NCO content)
  - water / moisture reacts with isocyanate group
  - forms unstable carbamate, dissociates to amine group
- Blocked component systems
  - oxime and phenol blocked isocyanates
    - heat usually removes blocking agent, reaction then with amine
  - blocked amines (aldimines)
    - moisture converts aldimine to amine, reaction then with isocyanate
- Others?

Polyurea Technology

- Introduced in 1987 in USA
- Volume usage in 1990, < 1,000 gallons

  < 3785 liters
- 2005 Volume, 18 – 20 million gallons

  62 – 76 million liters
  - **This is Worldwide!**

From Polyurea Development Association (2003), Skeist Report (2004)

Polyurea Advantages

- Fast reactivity, set and cure: rapid return to service
- Insensitivity to ambient temperature
- Contains no Solvents, no VOC's & little to no odor
- Flexible, seamless and resilient
- Excellent mechanical properties

Polyurea Usage

- Concrete coatings and linings
  - Water & wastewater, chemical, water proofing
- Steel coatings
  - Corrosion / abrasion protection, tank lining
- Molding work

Formulation Types

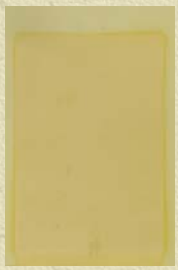
- **Aromatic Based**
  - Excellent systems – “work horse”
  - Limited color stability
  - Some systems may “green” in color

Formulation Types

- **UV Stability - Aromatic Based Systems**


250 hours


3000 hours


3250 hours


3000 hours

QUV Weatherometer testing, ASTM G-53 , UVB-313 bulbs

Formulation Types

- Aromatic Based
- **Aliphatic Based**
  - Excellent color stability
  - Still fast set technology
  - OEM applications

Formulation Types

- Aromatic Based
- Aliphatic Based
- **Aliphatic Modified**
  - Limited color stability
  - Will change when exposed to UV light

Formulation Types

- Aromatic Based
- Aliphatic Based
- Aliphatic Modified
- **Polyaspartic Ester System**
  - Thin film application
  - Slow set
  - Excellent color stability
  - Not as flexible

Formulation Types

- High Temperature Glass Transition

System Type	T_g, °C
Aromatic based	230 - 260
Aliphatic based	60 - 80
Polyaspartic ester	60 – 80

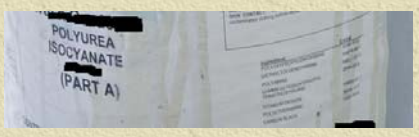
Low temperature T_g, °C is about -40 to -50°C

Formulation Types

- **Must supply proper data / information / label**

Isocyanate component

description of Resin blend



Resin Blend component

description of Isocyanate

Shrinkage Characteristics

- **Polyurea is a thermoset material, not a thermoplastic**
- **As with all thermoset materials, there is some "shrinkage" associated with cure**

Shrinkage Characteristics

- Faster set, harder systems shrink more than the slower set, higher elongation systems
- Formulation and processing dependant
- Linear shrinkage values noted:

  0.5 up to 5% linear

Set and Cure

- Polyurea technology noted as “fast cure”
- Really a fast set technology
- Overall cure faster than other technologies
  - Epoxy, polyurethane, vinyl ester

Set and Cure

- **Cure Time:** The period of time when a polyurea material attains it's ultimate physical properties.
- **Caution** here as many systems may reach a "cure point" within a short period of time that would allow use in a particular application, but have **NOT** reached ultimate physical properties. The cure time varies on different formulations, with the high hardness, low elongation systems reaching full cure faster that the slower, higher elongation systems. This ultimate "cure" may be 24 to 48 hours plus after application.

Set and Cure

- Faster set / gel system may not properly wet the substrate for adhesion
- Faster set systems may also have issue with overspray
- When can you return to service / expose to traffic?

Adhesion

"Polyurea" is not an excuse **NOT** to perform the proper / required surface preparation.

Adhesion

- Polyurea systems (formulated properly) exhibit excellent adhesion to properly prepared substrates
- Concrete (ASTM D 7234)
  - SSPC-SP 13 / NACE No. 6
  - ICRI CSP 3 to CSP 6 for optimum performance
  - Primer usually required
- Steel (ASTM D 4541)
  - SSPC-SP 10 / NACE No. 2 to SP 5 / No. 1 for optimum performance
  - Min 2 – 3 mil (50 – 80 µm) profile
- **Adhesion should not be an "add-on"**

Primers

- Typically required to enhance adhesion
  - Porous substrates
  - Reduce or eliminate pinholing
- Epoxy or polyurethane based
  - Should be matched to the polyurea system
- Only as good as what you are sticking to!

Immersion Service

Can “polyurea” systems be used for immersion applications?

Immersion Service

Can “polyurea” systems be used for immersion applications?

YES!

Immersion Service

Immersion Service

- Important criteria:
  - Properly formulated system
  - Moisture Vapor Transmission understanding
  - **MUST** be pinhole free
    - Especially for wastewater applications
  - **MUST** be processed properly

Chemical Resistance

- Similar to polyurethanes - polyether backbone
- More resistant to hydrolysis (urea linkage)
- Better alkali resistance (high pH)
- Exposure temperature significantly affects performance
- Some formulation subject to oxidation
- “Modified” systems showing improved performance

Application Equipment

- Plural component spray application
  - Capable of high, continuous flow
  - Heating is required
- Equipment setup to application work
  - Downsize out to spray gun
  - Must have positive feed to unit
- Use the proper spray gun for the work and system

Applicator Training

- Offered by Polyurea System Supplier
  - Capable of high, continuous flow
  - Specific to their “polyurea” products
- Polyurea Development Association
  - Polyurea Spray Applicator Course
  - First course of it’s kind available to industry
  - Extensive and “hands on”, 4-day course
- Other Associations; SSPC and NACE

Conclusion

- Support the product
  - Performance data / testing
- Choose the proper system for the application
- Have application history
- Experience with application equipment
- Training programs available
- Working on new developments
- Ask Questions