Coatings Trends & Technologies

Novel Amine Curing Agent For Concrete Joint Filler Applications

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September 08, 2022
Chicago, IL

Agenda

- Background information and introduction
- Concrete joint filler formulations and testing plan
- Performance comparison
- Real world case study and testing results
- Conclusions

Background Information

- Two-component epoxy systems have been used for industrial protective coatings for many years due to their excellent adhesion to a wide range of substrates, superior chemical resistance and mechanical properties.
- For floor applications, fast return-to-service properties is very important to coating applicators and assets owners.
- Fast cure often leads to less flexibility and brittleness, so formulators must find a balance point between those two properties.

Our Solution

- A novel polyamide-based curing agent was developed, named as HPA here. It achieves:
  - Combination of hardness and flexibility
  - High water, chemical and solvent resistance
  - Fast curing at room temperature

Typical Properties and Targeted Applications

Properties:	HPA
Appearance	Amber Liquid
Color (Gardner)	< 9
Viscosity (mPa.s @ 25 °C)	15,000 – 30,000
AHEW (g/eq)	107

Concrete joint filler or adhesive

Concrete floor coatings

Industrial coatings and primers

High solid paint formulations

Performance Comparison

- A traditional polyamide, named PA here, was used to compare with this novel curing agent, HPA. Industrial standard Bis-A type epoxy resin was used for comparison.

Properties	HPA	PA
Gel time, Hours @ 25°C /200g mass	1	2.25
Tack-free time, Hours @ 25°C	5	6.5
Through cure time, Hours @ at 25°C	9	12

Chemical Resistance Performance

- Epoxy pucks were used for chemical immersion test.
- Initial weight and Shore D hardness were measured before being immersed in chemical solutions for 21 days. After immersion, weight and Shore D hardness were measured again.

Chemicals	Initial Shore D	Weight Gain	After Shore D
DI Water	77	2.7%	77
10% NaOH	73	1.6%	70
10% HCl	71	5.0%	70

Testing Plan

- A commercial concrete joint filler was chosen as the commercial control.
- Experimental concrete joint filler formula was developed based on Bis-A epoxy resin and HPA. Part A and Part B mix ratio is 1:1 by weight.
- Tensile strength and elongation were measured according to ASTM D638. Samples were cured for 7 days at RT before testing.
- Water absorption was tested by curing a 2-3g part for 7 days at RT, followed by submersion in a glass jar filled with water for 24h. Masses were recorded before submersion, and after submersion. Part was dried with a paper towel before being weighed.

Concrete Joint Filler Formula

Material Name	Type	Weight, gram
Part A		
Grind		
Epoxy Resin	Binder	62.40
TiO2	Pigment	16.20
Fumed Silica	Thickening	5.30
Talc	Extender	16.20
Total		**100**
Part B		
Grind		
$CaCO_3$	Extender	41.90
HPA	Hardener	33.60
AEP	Hardener	12.70
Accelerator	Accelerator	8.10
Fumed Silica	Thickening	3.50
Carbon Black	Pigment	0.20
Total		**100**

Concrete Joint Filler Performance Comparison

Properties	Control	Experimental Formula
Tensile, psi	2540	2860
Elongation, %	4.2	4.1
Water absorption, %	0.8	3.8
Pot life, hour	2	2.5

Smear Test

- Smear test is an important application property for concrete joint filler. It shows the workability window for smearing of fully formulated systems.
- In order to perform a Smear Test, the fully formulated system needs to be a putty-like consistency at 1 hour . Any excess should be scraped off easily from the testing surface (e.g. concrete).
- Part A and Part B were mixed until they became a putty-like constancy at 1 hour. ~2g of each system were laid out in a clump (~the size of a walnut) onto non-stick paper in order to perform Smear Tests at different time intervals.
- At each time interval, a knife is used to cut down the middle of the ~2g clump and then smear to determine the workability.

Smear Test Performance Comparison

System	Workability Window for Smearing Hour
Control	1.5
Experimental Formula	1.5

Real World Case Study of HPA For Concrete Joint Filler Application

- Customer was looking for improving the following performance on their existing product, while maintaining similar viscosity, tensile strength, elongation and pot life.
  - Lower cost
  - Lower water absorption
  - Faster hardness development

Case Study Results

Measured Characteristic:	Customer feedback results
Water Absorption	**80% reduction** compared to existing customer product
% Elongation	9.3%
Tensile Strength	8120 psi
Gel Time	1 hour
Compressive Strength	Satisfactory in customer application
Shore D Hardness	75-80
21-day chemical resistance	Satisfactory in customer application
Lap Shear	4400 psi after heat cure on steel

Conclusions

- Examining all the data, this novel curing agent brings faster curing speed than traditional polyamide amines while maintaining good flexibility and working time.
- In our experimental study, concrete joint filler based on this novel curing agent provides similar performance as commercially available product.
- In a real-world case study, this novel curing agent meets all the performance requirements from the customer while maintaining lower costs.

Thank you!

Questions?