Chemical Resistance of TRENCHCOAT™ Protective Film

TRENCHCOAT™ Protective Film is an extremely durable film that can be laminated to galvanized steel for subsequent forming into corrugated steel pipe (CSP). TRENCHCOAT Film provides both the inside and the outside of the CSP with exceptional corrosion and abrasion protection.

Corrugated steel pipe coated with TRENCHCOAT Protective Film is lighter than concrete pipe and asphalt-coated pipe, making it easier to transport, handle and install. It resists degradation by most acids, salts and alkalis commonly found in storm drains and culvert systems. TRENCHCOAT Film provides proven protection that endures – even in the most demanding applications where aggressive runoff is a problem.

As a guideline for applications in most severe conditions, TRENCHCOAT Protective Film was tested for chemical resistance in accordance with established ISO and ASTM methods.

The results show TRENCHCOAT Protective Film performs well against acids and bases at ambient temperature.

For organic solvents, specific requirements and temperature conditions need to be evaluated in order to determine the fit of TRENCHCOAT Protective Film.

The suitability of TRENCHCOAT Film for applications with exposure to aromatic hydrocarbons needs to be carefully tested before specification. Toluene, as an example for aromatic hydrocarbons, dissolved the film at 80°C (176°F).

The purpose of this summary is to report the findings of testing under ISO and ASTM conditions.

Specific applications might require additional and/or more specific testing.

Test Method

The chemical resistance of TRENCHCOAT™ Protective Film has been studied in accordance with method EN ISO 175 and ASTM D543.

Temperature of storage:

- Room temperature (RT) and 80°C (176°F)

Duration of immersion:

- 30 days and 90 days

Analysis:

- Gravimetric, tensile testing

Testing was done immediately after immersion and again after 24 hours had passed.

Test Substances

Water	H_2O (Tap water) H_2O demin. (Demineralized water)	
Bases	NaOH (Sodium hydroxide) NH_4OH (Ammonium hydroxide)	20% in water 25% in water
Acids	Sulfuric acid Nitric acid	25% in water 20% in water
Urea	Urea	10% in water
Organic solvents	Isopropanol (IPA) Acetone Ethyl acetate	
Aromatic hydrocarbons	Toluene	
Glycols	Polyethylene glycol	

Performance Report

TRENCHCOAT™ Protective Film

Specialty Plastics

Gravimetric Testing

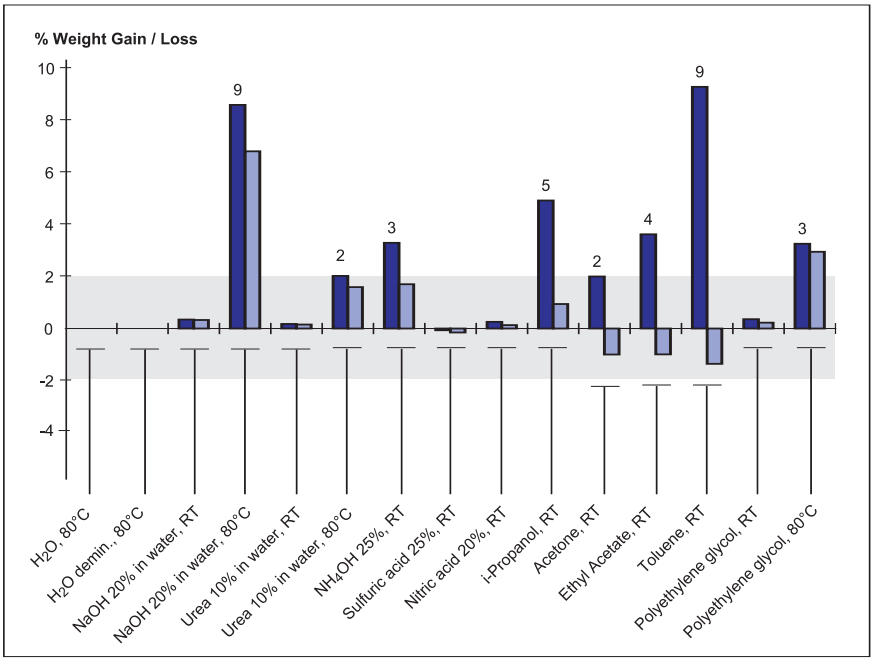
The specimens were weighed immediately after immersion and after 24 hours of drying.

A weight change of +/- 2% was considered to be insignificant.

TABLE 1: Gravimetric Results After 30 and 90 Days of Immersion

Chemical	Temperature	Weight Change, Immediately (%) (After 30 Days Exposure)	Weight Change, Drying 24 Hours (%) (After 30 Days Exposure)	Weight Change, Immediately (%) (After 90 Days Exposure)	Weight Change, Drying 24 Hours (%) (After 90 Days Exposure)	Comments
H_2O	80°C (176°F)	0	0	1	1	
H_2O demin.	80°C (176°F)	0	0	0	0	
NaOH 20% in water	RT	0	0	0	0	
NaOH 20% in water	80°C (176°F)	9	7	8	6	
Urea 10% in water	RT	0	0	0	0	
Urea 10% in water	80°C (176°F)	2	2	3	2	
NH_4OH 25%	RT	3	2	3	2	
NH_4OH 25%	80°C (176°F)	n.a.	n.a.	n.a.	n.a.	Test stopped immediately due to forming of gases
Sulfuric acid 25%	RT	0	0	0	0	
Sulfuric acid 25%	80°C (176°F)	n.a.	n.a.	n.a.	n.a.	Test stopped immediately due to forming of gases
Nitric acid 20%	RT	0	0	0	0	
Nitric acid 20%	80°C (176°F)	n.a.	n.a.	n.a.	n.a.	Test stopped immediately due to forming of gases
Isopropanol	RT	5	1	4	1	
Acetone	RT	2	-1	2	-1	
Ethyl acetate	RT	4	-1	3	-1	
Toluene	RT	9	-1	4	-1	
Toluene	80°C (176°F)	n.a.	n.a.	n.a.	n.a.	Stopped test because film dissolved
Polyethylene glycol	RT	0	0	0	0	
Polyethylene glycol	80°C (176°F)	3	3	4	3	

FIGURE 1: Gravimetric Results After 30 Days of Immersion



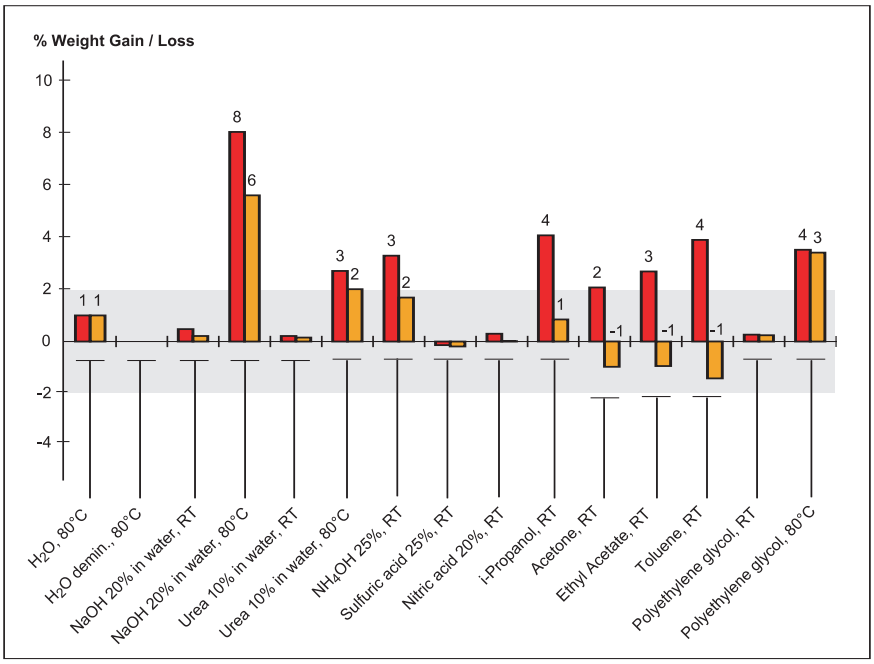
Test Conditions:
- Gravimetric evaluation
- **30 days immersion**
- at room temp and at 80°C (176°F)

Weight change, immediately
Weight change, after 24 h drying
Interval of significance

NH_4OH, Sulfuric acid and Nitric acid: Test at 80°C (176°F) stopped due to formation of gases

Toluene: Test at 80°C (176°F) stopped after 14 days due to dissolution of film

FIGURE 2: Gravimetric Results After 90 Days of Immersion



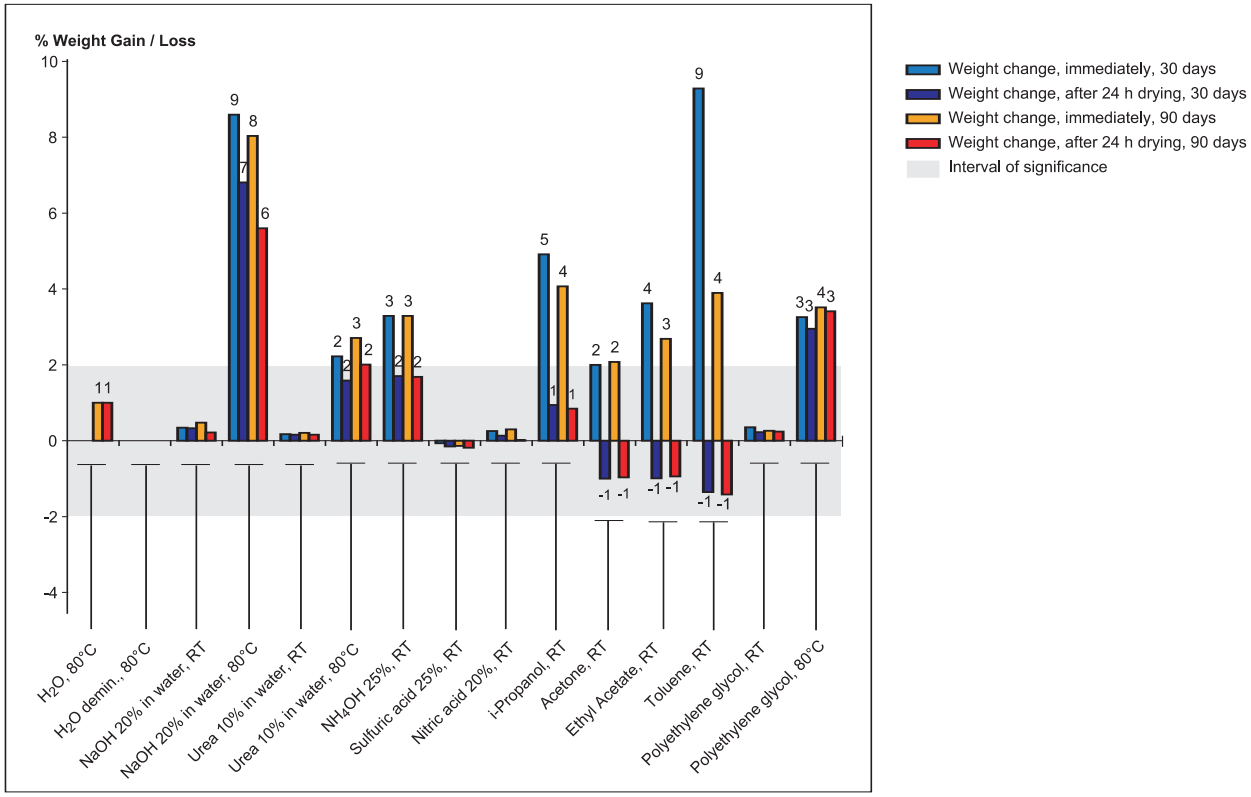
Test Conditions:
- Gravimetric evaluation
- **90 days immersion**
- at room temp and at 80°C (176°F)

Weight change, immediately
Weight change, after 24 h drying
Interval of significance

NH_4OH, Sulfuric acid and Nitric acid: Test at 80°C (176°F) stopped due to formation of gases

Toluene: Test at 80°C (176°F) stopped after 14 days due to dissolution of film

FIGURE 3: Comparison of Gravimetric Results – After 30 and 90 Days



Results of Tensile Testing

The specimens were tested after 90 days of immersion.

A change in tensile properties of +/- 10% was considered to be insignificant.

TABLE 2: Tensile Test Results

Chemical	Temp	% Change in Elongation	% Change in Max Load
TRENCHCOAT™	RT	Reference	Reference
NaOH 20% in water	RT	-9	-8
NaOH 20% in water	80°C (176°F)	13	-25
Urea 10% in water	RT	-6	1
Urea 10% in water	80°C (176°F)	-6	-7
NH_4OH 25%	RT	-17	-15
Sulfuric acid 25%	RT	-7	5
Nitric acid 20%	RT	-10	6
Isopropanol	RT	-27	-2
Acetone	RT	-12	-3
Ethyl acetate	RT	-16	-7
Toluene	RT	-9	-2
Polyethylene glycol	RT	-8	2
Polyethylene glycol	80°C (176°F)	-6	-13

FIGURE 4: Tensile Test Results – % Change in Max Load

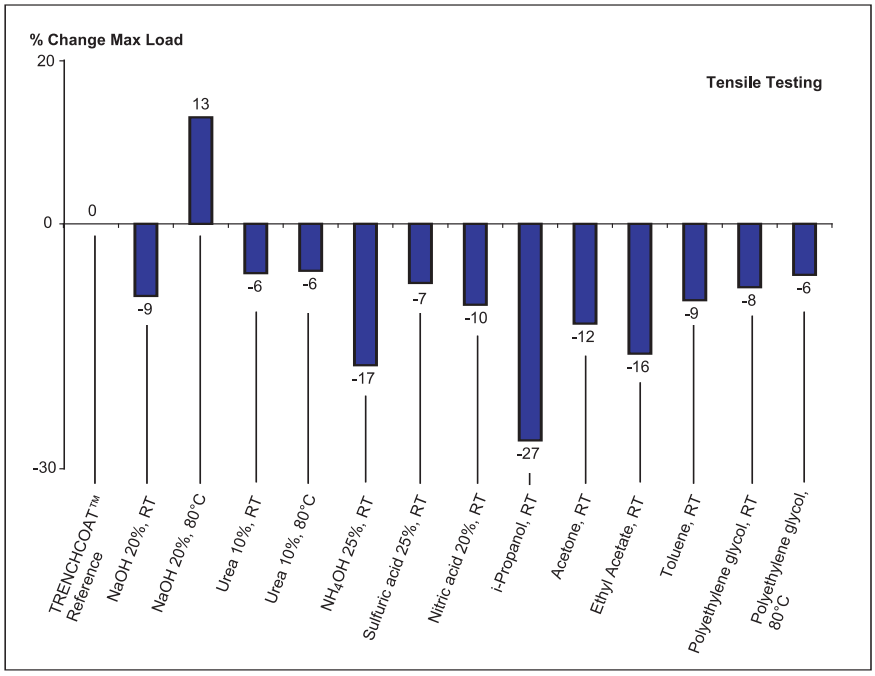
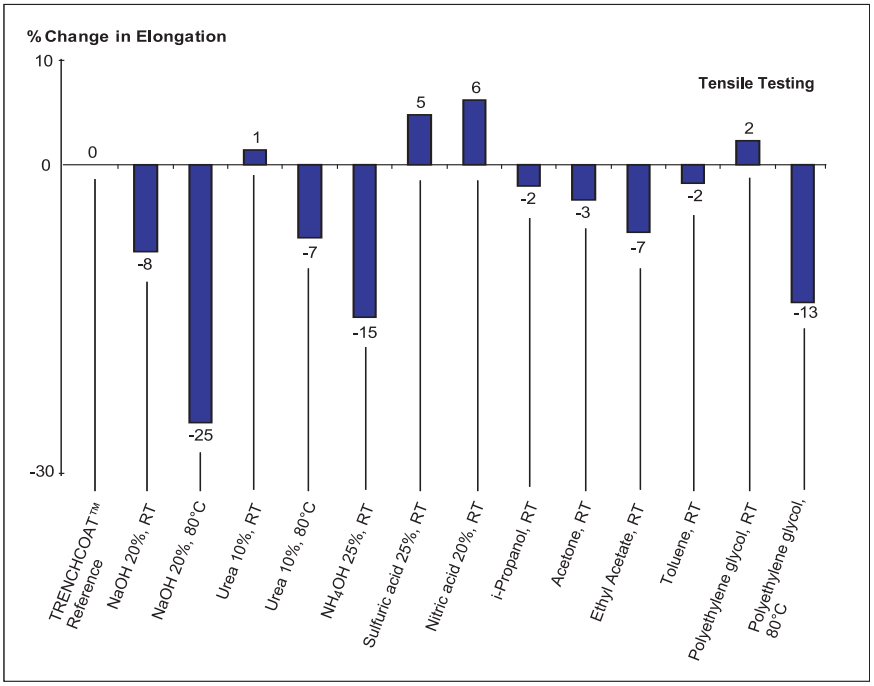


FIGURE 5: Tensile Test Results – % Change in Elongation



Summary

- At ambient temperature, TRENCHCOAT™ Protective Film performs well against strong acids and bases.
- For organic solvents, application-specific requirements will determine the suitability of TRENCHCOAT Protective Film for the application. More specific testing might be needed.
- Resistance of TRENCHCOAT Protective Film to aromatic hydrocarbons is limited (toluene dissolved the film at 80°C [176°F]). Any application involving exposure to hydrocarbons has to be carefully considered and tested.
- As expected, increasing temperature reduces the resistance of TRENCHCOAT Protective Film to chemical substances.
- In the gravimetric data, there is no significant difference in testing results between the 30 days and the 90 days exposure data. This means there is no indication that long-term exposure will significantly affect the resistance of TRENCHCOAT Protective Film against chemical substances. This finding is very much in line with case studies that demonstrate the 30+ year performance of TRENCHCOAT Protective Film in corrugated steel pipe applications.

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