



Life Time Storage Tank Exterior Corrosion Protection with 100% PVDF FLUOROSEAL® Coating

- ❖ >1000X better corrosive gases and moisture barrier than epoxy coating
- ❖ Impervious to petroleum products as inside tank corrosion protection coating

“Protection of metals from corrosion is a topical issue affecting all areas of the world’s economy. The losses due to the damage associated with marine transport corrosion during the period of construction or operation constitute approx. 50–80 billion USD and approx. 3 % of world GDP. Statistics show that 90% of ship failures are attributed to corrosion”

https://www.researchgate.net/publication/324045191_Corrosion_and_Wear_Analysis_in_Marine_Transport_Constructions

To be effective in protecting the oil storage tanks and pipes from corrosion damages, the coating must meet the following requirements:

- Field applicable coating onto the large areas of exposed structures both above and below waterline by roller or brush or spray coating method and “cure” at ambient.
- The coating must be itself resistant to UV exposure for more than 50 years: so that the protection coating does not need constant maintenance. The coating should also block UV from reaching underneath the coating to prevent UV damages to the structural coating on the structure.
- The coating must have ability to block moisture penetration. Lesser moisture penetration will prevent the water pockets to be accumulated inside the ship hull coating interface. Lesser moisture also reduces the possibility of Cl-, Na+ and other salt ions being carried along to cause corrosions.
- The coating should have the ability to block corrosive gases such as CO₂, H₂S from carried by the moisture or penetration and react with the retained waters inside the coating-steel interfaces.
- FLUOROSEAL® coating with PVDF molecular structures are proven to provide the highest barrier capabilities of field applicable coating.



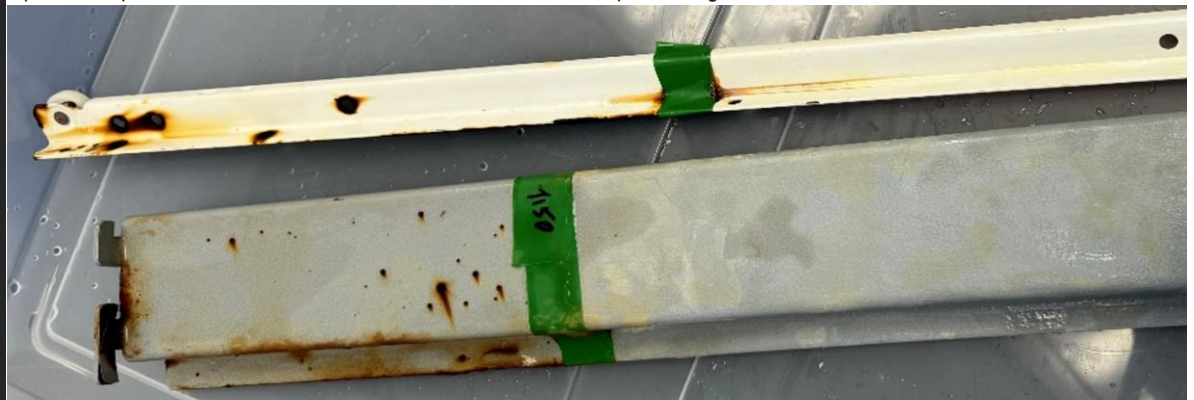
Storage tanks whether above ground (above ground storage tank, AST) or below ground (underground storage tank, UST) are used for store large quantity of fluid products of different kinds from water, waste water, to more regulated substances such as: petroleum; hazardous chemicals; nonpetroleum oils including biodiesel, synthetic fuels and oils, tung oils, wood-derivative oils, and inedible seed oils from plants; and pure ethanol for blending with motor fuels. Most of these tanks are made of steel that are vulnerable to corrosion from outside and inside.

All steel storage tanks are coated with epoxy and other coatings both inside and out for corrosion protection. The outside corrosion vulnerability depends on the environment that the tanks are located. More vulnerabilities to corrosion are faced by tanks that are located near sea, near heavy industries or areas that have more corrosive exhausts, and where UV exposure is intense that damages the epoxy or other protective coatings. The degrees of inside corrosion vulnerability depend on the contents and impurities of the contents that are being stored.

Leakages of stored products are costly both environmentally and financially. The Storage Tank and Spill Prevention Act (Act 32 of 1989, as amended) was signed into law on July 6, 1989. The law establishes a comprehensive regulatory program for both aboveground and underground storage tanks and facilities.

FLUOROSEAL® 100% PVDF field applicable coating is a patent-pending technology developed by AIT Coatings of AI Technology, Inc. to provide life-time corrosion protection for the exterior of the storage tanks.

For interior of storage tanks, FLUOROSEAL® 100% PVDF coating is impervious to petroleum products to provide unparalleled protection against both physio-chemical and microbiological bacteria induced corrosion. As top coating over existing epoxy coating or direct coating over steel, the special molecularly engineered 100% PVDF coating have proven to provide more than 100 times more effectiveness in preventing corrosion.



Steel bars coated with a gray and white epoxy coatings from commercial sources are partially coated with field applicable, patent-pending CPC7550 100% PVDF top coat (~50µm thickness). The portion protected by epoxy coatings only when exposed to salt-water (water with dissolved corrosive ions) suffered extensive corrosion in 65 days under the accelerated conditions of 60°C-5% saline solution. By comparison, epoxy coated steel when top coated with field applicable 100%PVDF coating showed no sign of corrosion. The accelerated conditions are roughly equivalent to 2-3 years of ambient temperature seawater submersion condition. That is, CPC7550 dramatically extend the operational time for ship at sea by years without needs for dry-docking.



Unparalleled Storage Tank Interior Corrosion Protection with 100% PVDF FLUOROSEAL® Coating

- ❖ Impervious to crude and refined oil induced deterioration for interior of storage tank
- ❖ >100X corrosive barrier than epoxy coating at 1/10 of thickness

Storage tanks built with steel are traditionally protected by paints of all kinds. Epoxy and/or polyurethane are predominant among them:

- Epoxy-Polyurethane molecules are vulnerable to UV degradation
- Epoxy-Polyurethane are molecularly porous with high permeability to moisture laden with corrosive acidic and ionic elements.
- Exterior of above ground storage tanks are vulnerable to UV and corrosion failure:
 1. UV induced molecular damages of epoxy-polyurethane coating to allow direct exposure of steel to corrosion.
 2. Gradual penetration of corrosive ions and/or acidic gases laden moisture.
- Interior of storage tanks are vulnerable to corrosion failure by:
 1. Gradual penetration of corrosive ions and/or acidic gases laden refinery atmosphere
 2. Under deposits such as water laden with chlorides, sulphates, and other corrosive acidic solutes.
 3. Microbiological bacteria and other bio-elements

FLUOROSEAL® PVDF Coatings:

1. Field Applicable Ambient Storage 1-Component VOC Compliant Coating
2. Apply Over the Existing Epoxy or Polyurethane Coatings
3. Air Drying to Clear Overcoat
4. Air-Drying, 100% PVDF top coating CPC7650 and CPC7550 for interior protection
5. Proven corrosion protection <75µm coating thickness
6. Proven UV blocking to protect the underlying epoxy-polyurethane
7. Proven moisture and rain barrier
8. Proven barrier to biological bacteria generated corrosive



Bottom plate corrosions for storage are common and sometimes at rate as much as 1-2mm/year. The "under deposit corrosion" are often caused by water laden with corrosive ions such as chlorides, sulphates, and microbiological bacteria. Epoxy coatings are not adequate as barrier to these corrosive elements.

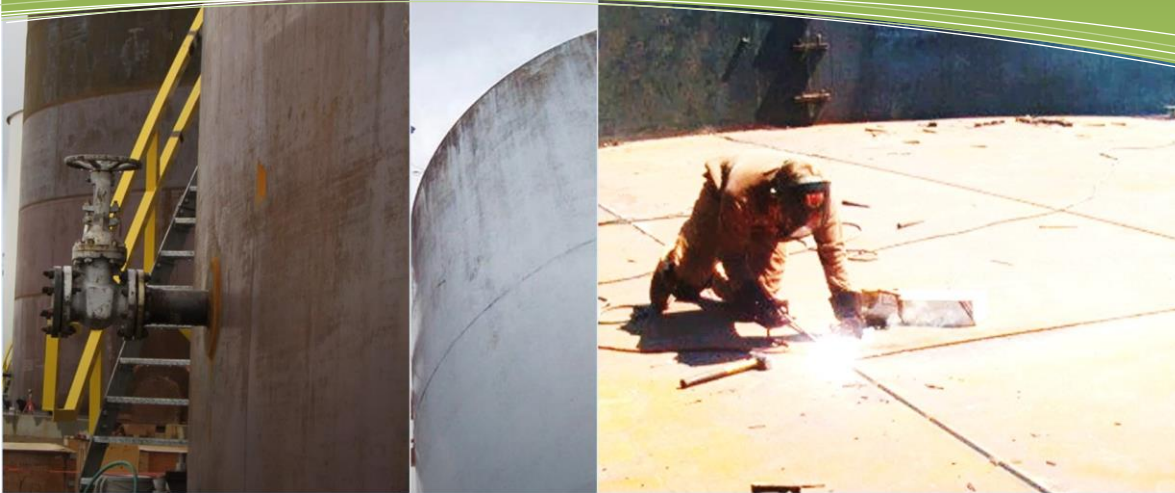
PHYSICAL CHARACTERISTICS OF FLUOROSEAL® PVDF Corrosion Protection Coatings

	CPC 7150	CPC 7650	CPC 7550
SPECIAL ATTRIBUTES	1) Transparent, flat finish 2) Primerless, VOC-Exempt Coating 3) Roller-Brush or Spray 4) Corrosion & antifouling	1) Transparent, flat finish 2) Primerless, VOC-Exempt Coating 3) Roller-Brush or Spray 4) Chemical and bacteria induced corrosion	1) Corrosion + Antifouling 2) Field Applicable 100% PVDF Protection 3) Roller or Spray 4) VOC Exempt Coating
WATER-MOISTURE PROPERTIES	STANDARD AND CONDITIONS (@25°C)		
Water Absorption (D570) %	<0.01 (Typical Acrylic: >0.4)	<0.01 (Typical Acrylic: >0.4)	<0.01 (Typical Acrylic: >0.4)
Water Permeability (gm.mm/m ² .d) @ 1atm	0.0009 (Typical Acrylic: >5.2)	<0.0009 (Typical Acrylic: >5.2)	<0.0009 (Typical Acrylic: >5.2)
Percentage of PVDF (%)	>70%	100%	100%
THERMAL PROPERTIES	STANDARD AND CONDITIONS (@25°C)		
Glass Transition Temp (T _g ,°C)	-45	-45	-45
"Melting Point" (°C)	>120	>120	>120
CTE (Coefficient of Thermal Expansion, ppm/°C)	95	75	80
Thermal Conductivity (BTU-in/hr-ft ² -°F)	1	1	1
Thermal Decomposition (°C)	>350	>350	>350
MECHANICAL PROPERTIES	STANDARD AND CONDITIONS (@25°C)		
Hardness (Shore D)	50	60	50
Tensile Modulus (Psi/Mpa)	40000/(275)	200,000/(1,375)	180,000/(1,238)
Flexural Modulus (Psi/Mpa)	30,000/(206)	150,000/(1,031)	135,000/(928)
Tensile Elongation (%)	300	100	300
OPTICAL PROPERTIES	STANDARD AND CONDITIONS (@25°C)		
Refractive Index (D542)	1.43	1.43	1.43
ELECTRICAL PROPERTIES	STANDARD AND CONDITIONS (@25°C)		
Dielectric Strength (KV/mil)	0.8	0.8	0.8
Volume Resistivity (ohm-cm)	1.8x10 ¹⁴	1.8x10 ¹⁴	1.8x10 ¹⁴



Above and Below Ground Storage Tank Corrosion Protection with 100% PVDF FLUOROSEAL® Coating

- ❖ >1000X better corrosive gases and moisture barrier than epoxy coating
- ❖ Impervious to petroleum products as inside tank coating
- ❖ Blocking off corrosive gases generated by microbiological bacteria growth

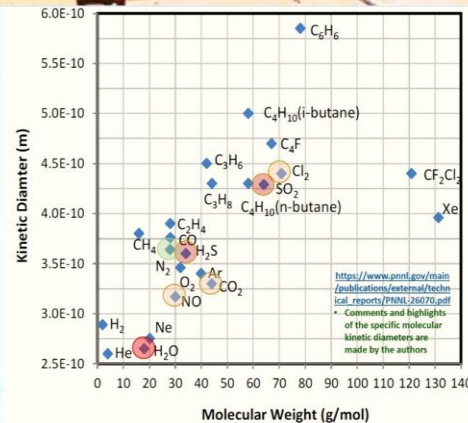
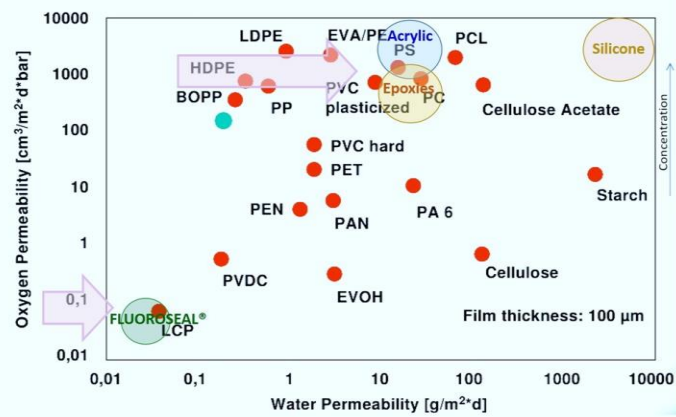


UV and Corrosion Protection Coating for Corrosion Protection:

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- Blocking moisture laden with carbonic acid from CO₂, other acidic gases and salt ions is key in reducing to eliminating these deleterious factors.
- Blocking moisture and acidic and corrosive gases from penetrating inside the concrete further stop corrosion and chemical reaction weakening.

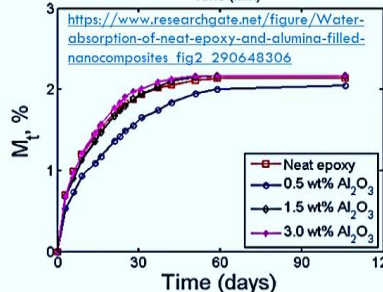
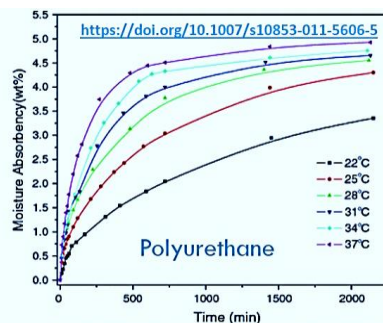
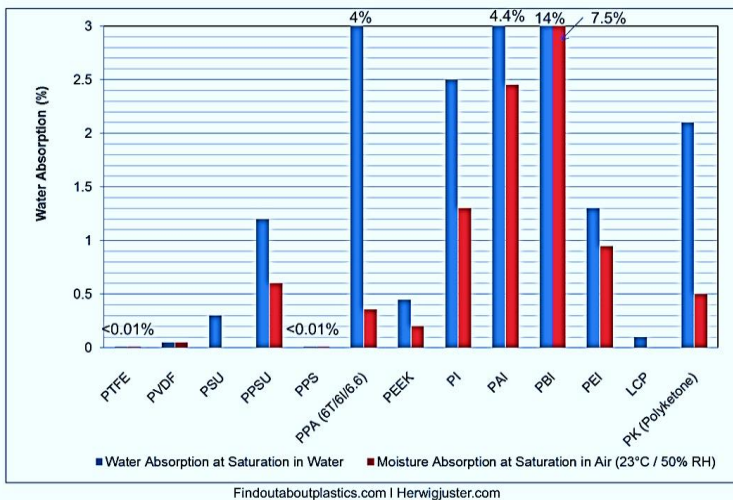


<https://www.slideshare.net/TopasAdvancedPolymers/high-aroma-barrier-films-for-food-packaging>

NOTES:
 • Smaller molecular kinetic diameter is easier to penetrate the lid-sealing adhesives and/or barrier coatings
 • Barrier against H₂O is even better barrier against larger kinetic diameter of the more corrosive gases such as H₂S and SO₂
 • He molecule has similar kinetic diameter to that of water vapor molecules and thus a good media for leaks comparison

FLUOROSEAL® PVDF is one of most densely molecularly packed coating to most effective in blocking H₂O moisture and O₂ that are the smallest kinetic diameter and thus orders of magnitude lower in permeability to the exhaust corrosive gases such as CO₂, H₂S, SO₂, NO, CO, Cl₂, etc., when compared to other traditional polymer coatings.

Design Properties for Engineers: Water and Moisture Absorption of High Performance Polymers



- In comparison to epoxy, polyurethane and alkyd coatings, FLUOROSEAL® PVDF coatings are molecularly engineered to have several orders less moisture absorption and lower in moisture and corrosive gases permeability to provide an effective sealing.
- FLUOROSEAL® sealing coating have 5B crosshatch and outstanding shear-bond strength to provide protection even in the more stringent environment.
- Coatings with low Tg molecular structure for stress absorption and proven extreme weathering cycle and exposures.
- FLUOROSEAL® PVDF sealing coatings are VOC-exempt for brush, roller and spray coating anywhere.

Besides having the highest capability in blocking moisture ingress (least moisture permeability), FLUOROSEAL® PVDF is molecularly packed to absorb and retain the least amount of water among all of the common coating polymers.

Oil and Gas Pipeline Transmission Corrosion Protection with 100% PVDF FLUOROSEAL® Coating

- ❖ Impervious to oil and gas induced deterioration for interior of transmission pipeline
- ❖ >100X corrosive gases and moisture barrier than epoxy coating at 1/10 of thickness



The table below summarizes the critical properties of FLUOROSEAL® Corrosion Protection Coating

Properties Required for Effective Protection of Steel Structures	Polyurethane	Epoxy	FLUOROSEAL® Coatings (CPC 7550, Clear, UV Blocking for Storage Tank & Pipeline Exterior) (CPC 7650 for Storage and Pipeline Interior)
Moisture-Water Permeability (Relative Ingress Number, g/m ² *d)	High (>20)	High (>20)	Very Low (<0.05)
Corrosive Gases (e.g. H ₂ S, C ₂ O, etc.) Permeability (cm ² /m ² *d*bar)	Very High (>2,000)	Very High (>2,000)	Very Low (<0.1)
Water Repellant	Fair	Fair	Good
Water Absorption (Retention)	Medium	Medium	Low
UV Molecular Stability (Resistance)	Fair (Proven <10 Years)	Fair (Proven <10 Years)	Outstanding (Proven >60 Years)
Choices of Color	1. Colored 2. Customized	1. Colored 2. Customized	1. Clear 2. Customized
Field Application Method	Spray, Brush, Roller (1-or 2-Component, Ambient Storage, Coating Liquid)	Spray, Brush, Roller (1-or 2-Component, Ambient Storage, Coating Liquid)	Spray, Brush, Roller (1-Component, Ambient Storage, VOC Exempt, Coating Liquid)
Cost of Material and Labor	Similar for material and Labor for the same performance level (Thicker: >200 Micron)	Similar for material and Labor for the same performance level (Thicker: >200 Micron)	Similar for material and Labor for the same performance level (Thickness: 50 Micron)



Epoxy pipeline interior coating is vulnerable to weakening by inherent semi-polar components, and acidic impurities. FLUOROSEAL® 100% PVDF are inert to these corrosive elements.

About AI Technology, Inc. and AIT Coatings Division:

With the introduction of FLUOROSEAL® concrete and corrosion protection coating solutions (patents pending), AITCOATINGS Division builds on the modified PVDF technology to provide field applicable high fluoropolymer protection for stopping weakening of concrete buildings and infrastructure. As top coatings, FLUOROSEAL® corrosion protection coatings can extend existing coated steel structures years more maintenance free services.

AIT develops and manufactures its product in two separate ISO 9001:2015 certified facilities totaling over 100,000 sq ft on a 16 and 18-acre in New Jersey, USA. AIT also has worldwide sales operations along with service centers in Africa and China. Since pioneering the use of flexible epoxy technology for electronic packaging in 1981, AI Technology (AIT) has been one of the leading forces in developing advanced materials and adhesive solutions for electronic interconnection and packaging with more than 30 patented technologies.

THE COMBINED CAPABILITIES OF FLUOROSEAL® PVDF COATING IN BLOCKING MOISTURE LADEN WITH SALT IONS AND DISSOLVED CORROSIVE GASES, AND UV RESISTANCE ENABLES CORROSION PROTECTION OF STORAGE TANK AND TRANSMISSION PIPE:

- Direct coating over coated or bare steel surfaces will protect the steel structure both above and below the seawater line for years without corrosion.
- Applying the FLUOROSEAL® to the existing coated steel tanks and pipelines exterior will “arrest” and stop the further corrosion damaging effects from the weathering.
- In the case of oil tank and transmission pipeline and storage tank interior, 100%PVDF FLUOROSEAL provides unparalleled corrosion protection to physio-chemical and bacteria induced corrosions.

SLOWING AND DEGREASE MICRO-INDUCED CORROSION:

- The low surface energy and the unparalleled ability in blocking corrosive gases generated by micro and bacteria growth have been proven to provide reduction of growth for interior tank and pipe corrosion.