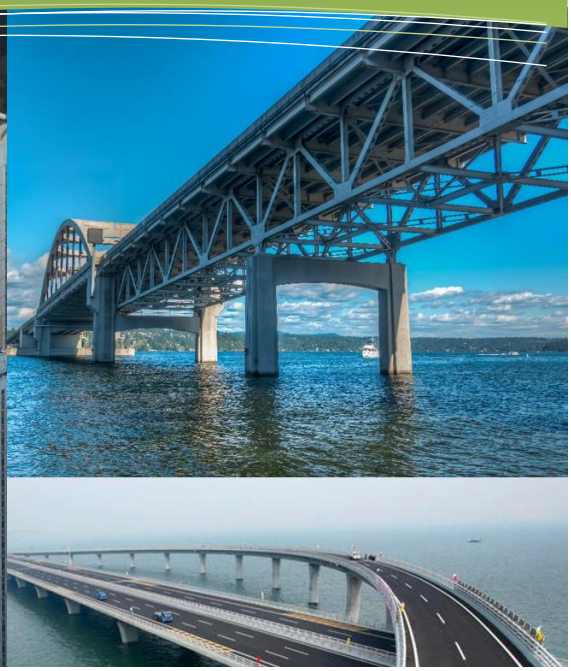
# WHY DOES SEEMINGLY INDESTRUCTIBLE CONCRETE BUILDINGS AND INFRASTRUCTURE NEED PROTECTIVE COATING?



***"Concrete is mostly damaged by the corrosion of reinforcement bars due to the carbonation of hardened cement paste or chloride attack under wet conditions"***

https://en.wikipedia.org/wiki/Concrete_degradation

To be effective in protecting the steel infrastructure, reinforced concrete from concrete carbonation and weathering weakening and rebar corrosion weakening, the coating must at least meet the following requirements:

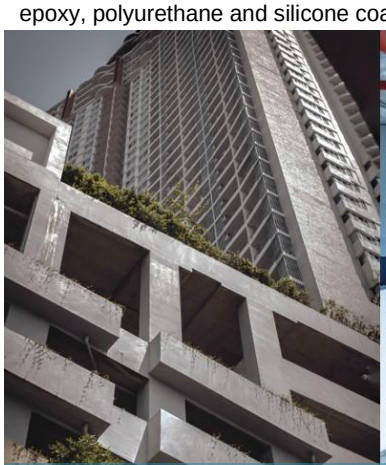
- Field applicable in coating onto the large areas of exposed reinforced concrete structures. That is by roller or brush or spray coating method and "cure" at ambient.
- The coating must be itself resistant to UV exposure for more than 50 years: so that the protection coating does not need constant maintenance. Preferably, the coating should also block UV from reaching underneath the coating to prevent UV damages to the structure or other coating on the structure.
- The coating must have ability to block moisture penetration inside the concrete. Lesser moisture penetration will prevent the water pockets to be accumulated inside the concrete pores and concrete-rebar interface. Lesser moisture also reduces the possibility of Cl-, Na+ and other salt ions being carried along to cause alkalization and rebar corrosions.
- The coating should have the ability to block corrosive gases such as $CO_2$, $H_2S$ from carried by the moisture or penetration and react with the retained waters inside the coating-steel interfaces, the concrete pores and rebar-concrete interfaces. FLUOROSEAL® coating with PVDF molecular structures are proven to provide the highest barrier capabilities of field applicable coating.

***"Permeability of concrete can be a primary reason for concrete deterioration due to reinforcing steel corrosion and other deterioration mechanisms." (American Institute of Concrete)***

Reinforced concrete and their proven strength and durability is the foundation of all the beautiful and long-lasting high-rise buildings and infrastructures. The partial collapsed of the Florida Champlain Towers South (a 12-floor condominium in Surfside) on June 24, 2021, is shaking the building industry. There is now an industry call to revamp how high-rise buildings are to be constructed. "A contributing factor under investigation is long-term degradation of reinforced concrete structural support in the basement-level parking garage under the pool deck, due to water penetration and corrosion of the reinforcing steel."

Even if new buildings and infrastructures may be built with redundancy and improved concrete, there are millions of buildings in existence that have been and still faces gradual concrete-rebar corrosion induced by corrosive gases such as CO2, H2S, SO2, NO, etc. Unprotected concrete encasing the rebars are still subjected to carbonation, alkalization, and other concrete weakening chemical reactions by the dissolved salt ions and acidic solutes that carried by moisture penetrating the concrete.

More frequent inspections or better testing or inspection methods have not been proven to help predict the vulnerability of the concrete structure that have been exposed to years of carbonation and rebar corrosions to different degrees depending on their geo-zone and environmental locations. FLUOROSEAL® PVDF concrete protection coatings are first of its kind that can be spray-roller-brush coating directly onto concrete in the field and on existing buildings. PVDF, PTFE and other highly packed fluorinated polymers are molecularly structured and have been proven to have the highest molecular packed density and thus lowest molecular pores to provide the barrier coating with several orders of magnitude lower permeability for moisture and corrosive gases than acrylic, epoxy, polyurethane and silicone coatings.



***Underground** and lower level garage floors are where all of the major supporting columns and beams are located. These floors and spaces are least protected with façade from concrete chemical reactions and rebar corrosion while more exposed to the vehicle exhaust corrosive gases, moisture-water, and salt-fog or salt-spray when near the sea.*

# Tunnels Like Garages Are More Exposed to Exhaust Corrosive Gases and High Humidity

- **FLUOROSEAL® Concrete Protection Coatings blocks these acidic corrosive gases and moisture laden with dissolved corrosive gases and salt ions to provide years of low maintenance protection**

**FLUOROSEAL® PVDF Concrete Protection Coatings with unparalleled ability to block moisture and corrosive gases that are free or dissolved and carried by moisture is a patent-pending solution in protecting buildings and critical infrastructure:**

Tunnels are enclosed spaces with typically with higher humidity and unusual amount of exhaust corrosive gases from vehicular traffics. Garages as individual structure or as part of a high-rise building subjects more stress and corrosion factors. As part of the high-rise building, they are where all of the load bearing columns are located. In fact, the June 24, 2021, Champlain Towers South, 12-story condominium in the Miami suburb of Surfside, Florida, United States, partially collapsed, causing the deaths of 98 people started at the basement.

*"A contributing factor under investigation is long-term degradation of reinforced concrete structural support in the basement-level parking garage under the pool deck, due to water penetration and corrosion of the reinforcing steel."*

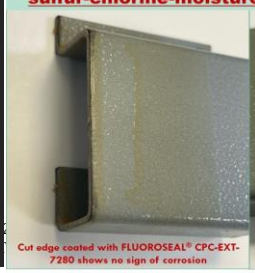
Both tunnels and parking garages are vulnerable to:

- Faster moisture and water to collected at the rebar-concrete interfaces when carrying dissolved salts and acidic exhaust gases, they cause rebar rusting and concrete strength weakening.
- Carbonation with more carbon dioxide reacts with calcium hydroxide in the concrete to form calcium carbonate and concrete weakening while at the same time causing rebar corrosion.
- Dissolved salt ions react chemically to further weaken the encasing concrete besides rusting steel rebars.
- Load bearing columns accelerate the moisture and corrosive elements to penetrate to cause the corrosion at stress concentration areas and spread to other areas.

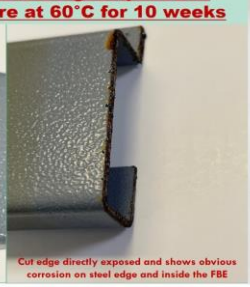
## PHYSICAL CHARACTERISITCS OF FLUOROSEAL® PVDF Concrete Protection Coatings

| | CRC-V 7150 | CRC-H 7280 | CRC 7550 |
|---|---|---|---|
| **SPECIAL ATTRIBUTES** | 1) VOC-exempt<br>2) Brush, roller or spray coating<br>3) Transparent coating-sealant for verticle concrete surfaces | 1) VOC-free<br>2) Brush or spray coating<br>3) Transparent hard coating for vehicle-foot traffic | 1) VOC-free<br>2) Brush or spray coating<br>3) Corrosion + Antifouling 100% PVDF Protection |
| **WATER-MOISTURE PROPERTIES** | STANDARD AND CONDITIONS (@25ºC) | | |
| 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/m².d) @ 1atm | 0.0009 (Typical Acrylic: >5.2) | 0.0009 (Typical Acrylic: >5.2) | 0.0009 (Typical Acrylic: >5.2) |
| Percentage of PVDF (%) | >70% | >70% | 100% |
| **THERMAL PROPERTIES** | STANDARD AND CONDITIONS (@25ºC) | | |
| Glass Transition Temperature (Tg,ºC) | -45 | -45 | -45 |
| "Melting Point" (ºC) | >120 | NA (Cured & Cross-linked) | >120 |
| Coefficient of Thermal Expansion (ppm/ºC) | 95 | 70 | 80 |
| Thermal Conductivity (BTU-in/hr-ft²-ºF) | 1 | 1 | 1 |
| Thermal Decomposition (ºC) | >350 | >350 | >350 |
| **MECHANICAL PROPERTIES** | STANDARD AND CONDITIONS (@25ºC) | | |
| Hardness (Shore D) | 50 | 85 | 80 |
| Tensile Modulus (Psi/Mpa) | 40000/(275) | 200,000/(1,375) | 180,000/(1,238) |
| Flexual Modulus (Psi/Mpa) | 30,000/(206) | 150,000/(1,031) | 135,000/(928) |
| Tensile Elongation (%) | 300 | 30 | 300 |
| **OPTICAL PROPERTIES** | STANDARD AND CONDITIONS (@25ºC) | | |
| Refractive Index (D542) | 1.43 | 1.43 | 1.43 |
| **ELECTRICAL PROPERTIES** | STANDARD AND CONDITIONS (@25ºC) | | |
| Dielectric Strength (KV/mil) | 0.8 | 0.8 | 0.8 |
| Volume Resistivity (ohm-cm) | $1.8x10^{14}$ | $1.8x10^{14}$ | $1.8x10^{14}$ |

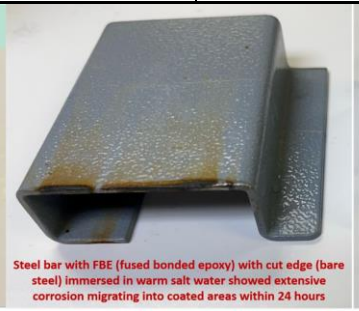
**FBE coated steel bar cut edge exposed to sulfur-chlorine-moisture at 60°C for 10 weeks**



Cut edge coated with FLUOROSEAL® CPC-EXT-7280 shows no sign of corrosion



Cut edge directly exposed and shows obvious corrosion on steel edge and inside the FBE

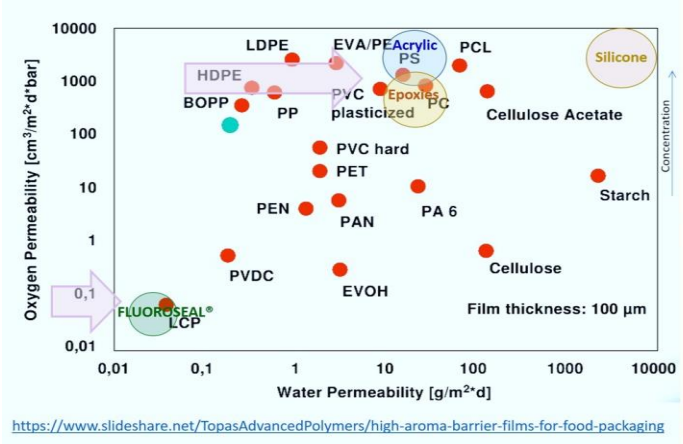


Steel bar with FBE (fused bonded epoxy) with cut edge (bare steel) immersed in warm salt water showed extensive corrosion migrating into coated areas within 24 hours

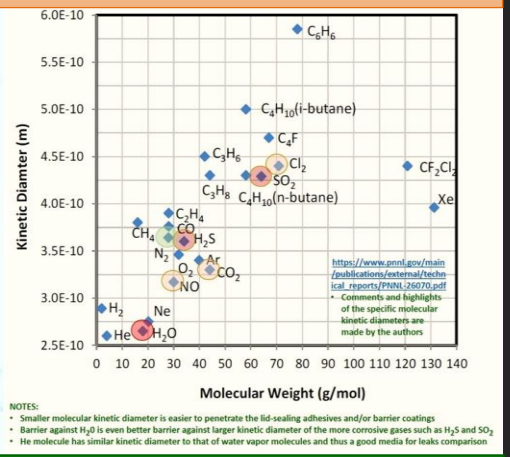
Same steel bar with FBE (fused bonded epoxy) with cut edge with exposed steel coated with FLUOROSEAL® CPC-7150 immersed in the same warm salt water showed NO SIGN of corrosion or any migrating into coated areas

# Concrete buildings and infrastructure are susceptible to concrete chemical reaction and steel rebar corrosion weakening when not properly protected

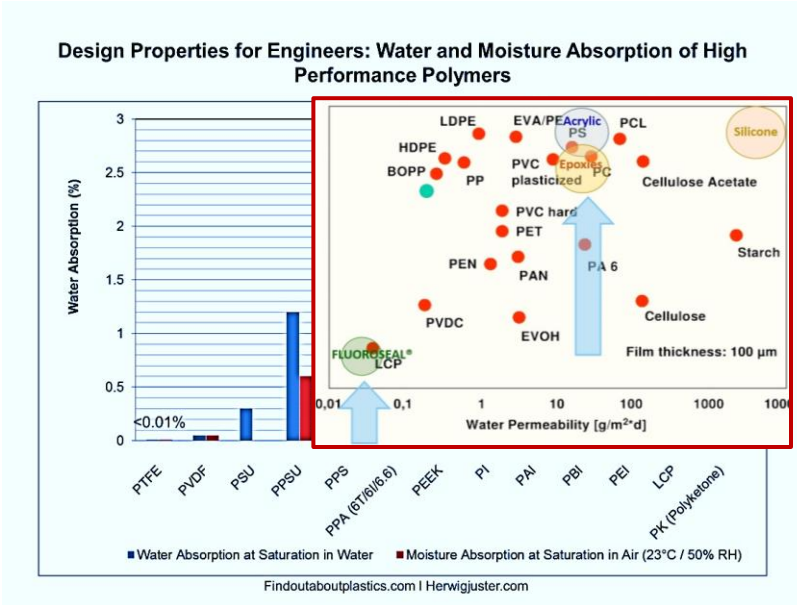
*"Concrete is mostly damaged by the corrosion of reinforcement bars due to the carbonation of hardened cement paste or chloride attack under wet conditions"* https://en.wikipedia.org/wiki/Concrete_degradation

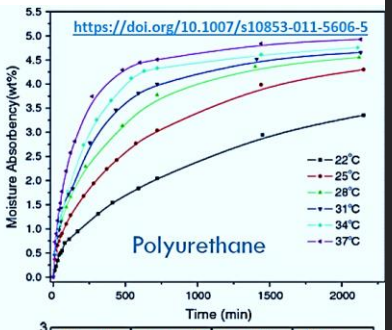


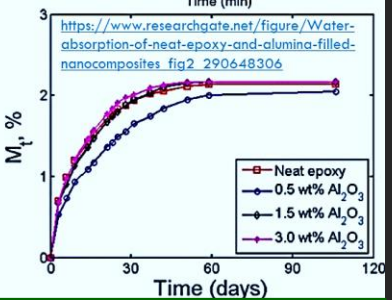

https://www.slideshare.net/TopasAdvancedPolymers/high-aroma-barrier-films-for-food-packaging




**FLUOROSEAL® PVDF is one of most densely molecularly packed coating to most effective in blocking $H_2O$ moisture and $O_2$ that are the smallest kinetic diameter and thus orders of magnitude lower in permeability to the exhaust corrosive gases such as $CO_2$, $H_2S$, $SO_2$, NO, CO, $Cl_2$, etc., when compared to other traditional polymer coatings.**




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

## Transparent UV and Corrosion Protection Coating for Reinforced Concrete and Corrosion Protection:

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- Blocking moisture laden with carbonic acid from $CO_2$, 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.
- 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.
- FLUOROSEAL® PVDF crosslinked series coatings are hardened for use on rooftop and walkway.

# Buildings and infrastructure near seas are vulnerable to salt-spray and fog laden with dissolved salts and corrosive gases penetrating into concrete pores and concrete-rebar interfaces

| Properties Required for Effective Protection of Steel Structures | Polyurethane | Epoxy | FLUOROSEAL® Corrosion Protection (CPC-EXT-7150, Clear, UV Blocking) (CPC-EXT-7280, Crosslinked, Abrasion Resistant) (CPC-EXT-7284 Crosslinked with Biocide) |
|---|---|---|---|
| Moisture-Water Permeability (Relative Ingress Number, g/m²*d) | High (>20) | High (>20) | Very Low (<0.05) |
| Corrosive Gases (e.g. $H_2S$, $C_2O$, etc.) Permeability ($cm^3/m^2*d*bar$) | 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) |

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

## 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.

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### How to protect the existing buildings and infrastructure with FLUOROSEAL concrete protection coatings?

- Direct coating over exposed concrete surfaces will protect the concrete and rebar from moisture, moisture laden with ions and corrosive gases.
- Applying the FLUOROSEAL® CRC-V-7130, CRC-H-7280 and CRC7550 to the existing concrete structures that may be in existence for years, will **"arrest" and stop the further damaging effects from the weathering.**
- The most important part of the protection is to **apply onto the columnar supports and parking garages t**hat are exposed to $CO_2$ and Sulfide exhaust are more prominent corrosive elements.
- Those **building and infrastructure near the seas** with high salt-spray carrying the salt ions will also prevent further damages.
- Those in infrastructure and building in temperate zones that are **subjected to possible water trapped inside the concrete from freezing expansion stresses** is also important.

### For the protection of the infrastructure with painted steel superstructure and concrete FLUROSEAL® Corrosion Protection Coatings afford with the combination of three abilities:

1. Blocking UV rays from reaching and damaging the epoxy-acrylic-polyurethane protective coatings
2. Blocking water and moisture laden with dissolved salts and corrosive acidic gases from passing through the epoxy-acrylic-polyurethane coating layer to reach the steel-coating interfaces
3. **Blocking moisture and corrosive gases** from penetrating and reaching the steel-coating interfaces