

FYFE Co. LLC "THE FIBRWRAP® COMPANY"

TYFO® CIS

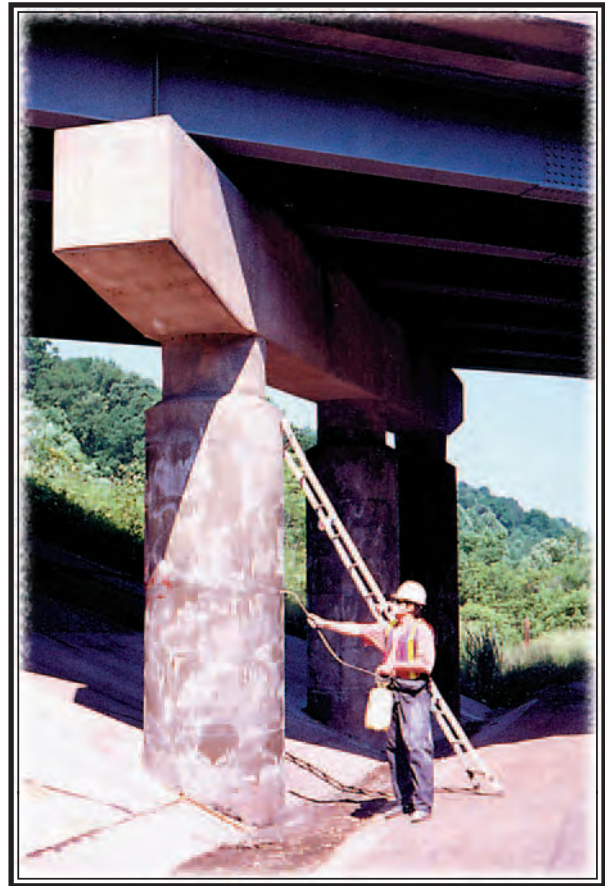
Corrosion
Inhibitors
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TYFO® CIS System for “Extending-The-Life” of Reinforced Concrete using Corrosion Inhibitors

The TYFO® CIS System increases the service life of reinforced concrete structures that are subject to corrosion. TYFO® CIS makes use of both chemical and physical components to inhibit corrosion, and increase the integrity of the structure.

All unsound materials, both steel and concrete, are removed and the exposed steel is abrasively cleaned. The TYFO® CIS System corrosion inhibitors are applied to the concrete surface. First, CIS-Layer 1 is applied, which in the vapor phase, migrates through the concrete to reach the rebar reinforcement to form a corrosion inhibiting film on the steel surface. Secondly, CIS-Layer 2 is applied, which in the liquid phase, reacts to reduce porosity, chloride, ions, buffers the concrete, balances the pH and increases strength characteristics. Laboratory tests and ten years of commercial use have established the performance of these corrosion inhibitors.

The TYFO® Fibrwrap® Jacket provides an external layer of protection, which limits the further introduction of corrosive agents to the structural member and replaces lost strength. By limiting the ingress of moisture and oxygen, the corrosion process is restricted. The jacket also helps to lock in the CIS corrosion inhibitor.



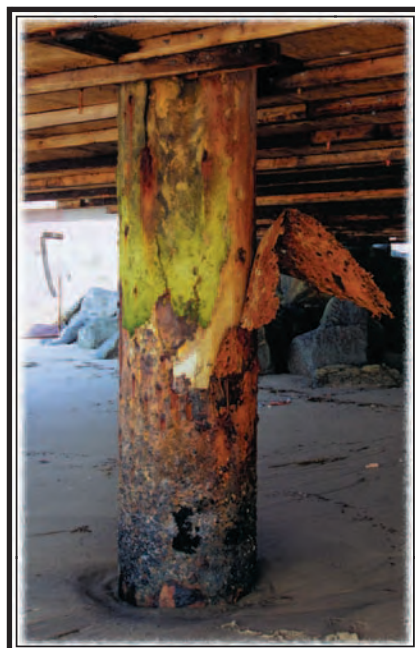
West Virginia bridge columns treated in May 1998

The TYFO® CIS System Features:

- TYFO® CIS System uses an electro-chemical corrosion inhibiting material.
- The material is spray-applied by onto the member surface (concrete).
- TYFO® CIS-Layer 1 migrates through the concrete, to coat and treat corroded rebar and concrete.
- TYFO® CIS-Layer 2 purges water soluble chlorides out of the concrete.
- Balances pH level to reduce corrosion rate.
- Documented reduction of half-cell potential (ASTM C-867).
- Fills porosity of concrete to inhibit penetration of moisture.
- Increases concrete compression and tensile strengths (ASTM C-42).
- Increases the density and hardness of the concrete, which improves bonding of patching materials (ASTM C-418).
- Neutralizes alkali-silica reactions.
- Converts existing rust into a hardened mass.
- Penetrates 2 to 3 inches into concrete.
- Restores concrete condition by elevating alkalinity and increasing compressive strength.

TYFO® CIS Treatment in Combination with the TYFO® Fibrwrap® System:

- Deters further intrusion of moisture, chlorides, and oxygen.
- Provides general protection for the existing element.
- Increases the general strength characteristics of the structural member.
- Increases confined concrete strength, shear strength, and axial load capacity of columns.





After preparation and application of the TYFO® CIS System, the beams were strengthened with the TYFO® Composite System



CIS Treatment System

Layer 1 Volatile Corrosion Inhibitor - Corrosion inhibitor vapor phase. This layer will sublimate and permeate the concrete as a gas and distribute itself uniformly to form a passive film on the corroded reinforcing steel. This layer is delivered in a liquid form and is spray-applied over the concrete area. Layer 1 is applied to the surface, which has been previously prepared for the proper bond of the patch material. Conventional concrete repair materials are used to restore lost sections of concrete.

Layer 2 High Penetrating Solution - Water-based liquid applied by roller or spray. Layer 2 controls the pH, purges and encapsulates water soluble chlorides, fills voids in the concrete, and inhibits further penetration of moisture. Layer 2 also acts as a contact corrosion inhibitor on the reinforcing steel.

What is TYFO® CIS?

The TYFO® CIS concrete restoration system is a water-soluble, odorless, clear, non-toxic, iron-petroleum inorganic and organic solution. The First Layer is a vapor phase monomolecular amine system. The Second Layer is a water-based, chemically modified silicate formulation that reacts in the matrix of the cement pores to produce a polymeric gel.

Why is TYFO® CIS superior to other systems?

- Layer 1 is used to form a corrosion inhibitor on both the steel and concrete.
- Layer 2 is unique, containing inherent chemicals, which can minimize or eliminate corrosion, and locally strengthen treated concrete. (Other systems lack this additional feature, which is unique in the concrete repair industry.)
- Our engineering approach, on a job-by-job basis, provides tailor-made designs for each project.



Fyfe Co. LLC's Engineering Approach

We simply ask for a sample of concrete from the application structure, and at no obligation to you, test it for pH level, chloride content, and porosity. We then suggest the best solution for your specific situation and provide the related cost estimate.

Fyfe Co. also provides in-field testing to determine the optimum CIS application.

Testing of the TYFO® CIS System

The performance of TYFO® CIS has been verified on numerous projects as well as through extensive independent laboratory testing. The results of the testing on concrete reflect the following —

Compression Strength - ASTM (American Society for Testing and Materials) C-42, increased by 300 to 2,000 psi, depending on original strength and number of layers applied.

Water Penetration Reduction - 100% resistance after 14 days exposure to 6 inch column of water. 75% resistance after 28 days exposure to 6 inch column of water. 90% resistance after 24 hours when 100 psi is applied.

Freeze-Thaw Resistance - ASTM C-672, 50 cycles with no surface loss. AASHTO (American Association of State Highway and Transportation Officials) T-161, 146 cycles with no surface loss.

Chloride Penetration Resistance - AASHTO T-250, 30% decrease of concentration at 1-inch depth. ASTM C-672, 42% decrease at 1-inch depth.

Water Soluble Chloride Reduction - reduced by 58% and 67% at 1 and 2-inches, respectively.

Increase in Hardness - ASTM C-418, 14% increase in hardness of new concrete. ASTM C-414, 64% increase in hardness of deteriorated concrete. ASTM C-501, 1,000 cycles with a 38% increase in wear index.

Reduced Rebar Corrosion - ASTM C-876, half-cell potential showed a reduced voltage by 70% in 14 days (0.8 to 0.3).

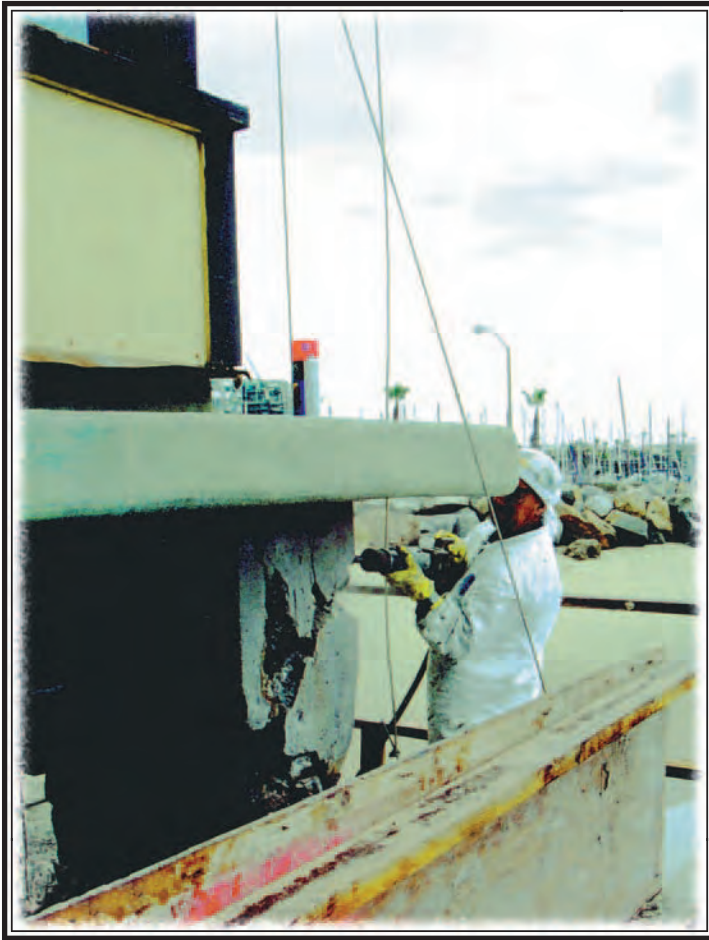
Increased Surface Adhesion - No failure of epoxy bond to treated surface.

Reduced Chemical Reactivity - Resists reaction with concentrated hydrochloric acid.

Flexural Strength - Increased from 423 to 543 psi.

Increases pH Level - At edges of concrete, value increased from 5 to 8; at center of concrete sample, value increased from 9 to 12.

A report on the system shows test results conducted by NASA at the Kennedy Space Center laboratories. Additional testing data is available upon request.



Typical Applications

- Columns, beams, walls, tanks, and other concrete elements.
- Water treatment plants.
- Parking facilities.
- Hazardous material storage facilities.
- Warehouses.
- Historical monuments and landmarks.
- Food processing plants.
- Heavy manufacturing facilities.
- Bridges.
- Highways and roads.
- Chemical plants.
- Ocean front properties.
- Airport tarmacs and runways.
- Steam and sewage treatment systems.
- Power generation plants.
- Facilities exposed to petroleum.
- Waste treatment storage and disposal facilities.
- Precast structures.
- Foundations and walkways.
- Cooling towers.
- Beachfront balconies.

Project Case Histories

A list of reference projects and case histories are available upon request.

Recommended Specification

Specifications for project applications are available upon request.

General Installation Procedure:

1. Remove unsound concrete and expose steel as required.
2. Apply TYFO® CIS Layer 1
3. Apply TYFO® CIS Layer 2
4. After a minimum of 12 hours, clean all exposed steel and concrete by abrasive methods.
5. Apply TYFO® CB (epoxy-modified concrete bonding agent) to all exposed steel as per Fyfe Co. LLC specifications.
6. Apply TYFO® P or PF (polymer-modified concrete) to reform the section as per Fyfe Co. LLC specifications.
7. Apply required TYFO® Fibrwrap® System as per Fyfe Co. LLC specifications.



The TYFO® CIS System was applied to these severely corroded concrete members in Redondo Beach, CA to deter further corrosion

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