SIKA CORROSION RESISTANT CONCRETE TECHNOLOGY

Sika® Ferrogard®-901 Concrete Admixture
Concrete is an ingenious building material, also because in combination with reinforcing steel it exhibits tremendous load-bearing capacity. The combination of steel and concrete has the advantage that under normal conditions the high pH value of concrete creates a passivating layer of iron hydroxides on the steel surface which protects it from corrosion. Particularly steel, however, can be compromised in its durability of performance by the presence of moisture and salt.

**Working mechanism of Sika® FerroGard®**

Chlorides are displaced at the steel surface by Sika® FerroGard®. It forms a protective film which moves the corrosion potential and reduces the current densities to a very low level.

Standard construction practices ensure that corrosion of steel reinforcements is limited. These practices include observance of minimum concrete quality (w/b-ratio, cement content, minimum strength) and minimum concrete cover of rebars. However, in many cases, especially in environments with high levels of chlorides (de-icing salts, seawater or even contaminated concrete mix components), these basic protection procedures prove insufficient. In order to prevent corrosion or delay its start and thereby extend the life of a structure, three additional steps can be taken to protect the steel from corrosion:

- Increase concrete quality
- Utilize corrosion inhibitors and
- Application of protective coatings

Increasing concrete quality means reduction of the number and size of capillary pores. This increases the density in the concrete matrix and as a result hinders the transport of chlorides or CO₂ into the concrete. Reduction of the w/c-ratio through application of high range water reducers or use of supplementary cementitious materials like fly ash, silica fume or natural pozzolans represent opportunities in concrete technology to improve the mix design even more.

When choosing improved concrete quality for protection against corrosion, extra attention must be given to proper placement, curing of concrete and shrinkage potential of the concrete mix, as small cracks can allow chlorides or CO₂ to penetrate to the reinforcing steel regardless of the density of the concrete mix. Corrosion inhibitors are added to the concrete mix during the batching process.

Inhibitors do not significantly influence the density of concrete or impact the ingress of chlorides or CO₂, but act directly on the corrosion process. Corrosion inhibitors are defined in a number of ways. On one hand either as an admixture which will extend the time before corrosion initiates, or as one which reduces the corrosion rate of the embedded steel, or both, in concrete containing chlorides. Sika® FerroGard® 901 is a multifunctional corrosion inhibitor which controls the cathodic and anodic reaction. This dual action effect significantly retards both the onset and the rate of corrosion increases the lifetime of a structure.

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<th>Key Criteria</th>
<th>Performance Level</th>
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<tbody>
<tr>
<td>Corrosion Inhibition</td>
<td>Sika® FerroGard® 901 corrosion inhibitors delay the onset of corrosion and reduces the rate of corrosion by 65% versus control specimen after 400 days.</td>
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<tr>
<td>Protective Layer on Steel</td>
<td>Sika® FerroGard® 901 forms a protective layer on the reinforcing steel of high integrity measured at least 100 μm thickness.</td>
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<tr>
<td>Displacement of chlorides from steel surface</td>
<td>Sika® FerroGard® 901 forms a continuous film on the reinforcing steel and displaces chloride ions from the steel surface</td>
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Sika® FerroGard®-901

CORROSION INHIBITING ADMIXTURE

Description:
Sika® FerroGard®-901 is a liquid concrete admixture formulated to protect embedded reinforcing steel from corrosion, and to provide an effective means for extending the service life of concrete structures.

How it works?
In sound concrete, steel reinforcement is protected by the highly alkaline environment which deposits a passivating layer of iron oxides around the steel. This passivating layer can be broken down by a number of destructive mechanisms, including carbonation and chloride penetration. Once the steel loses its protective layer, corrosion can begin to occur. Steel corrosion is an electrochemical process consisting of two partial reactions, one at the cathode and one at the anode. Sika® FerroGard®-901 is an active, dual purpose inhibitor containing a combination of aminoaclohols, and organic and inorganic inhibitors. This protects both the anodic and cathodic parts of the corrosion cell. Due to its high vapor pressure, Sika® FerroGard®-901 penetrates through concrete to the steel reinforcement, where it is adsorbed onto the surface. Sika® FerroGard®-901 forms a continuous protective film around the steel presenting a physical barrier to chlorides and other deleterious substances. Because of its high affinity to steel, Sika® FerroGard®-901 is also able to displace chloride ions from the metal surface to protect concrete from chloride induced corrosion.

Applications:
- Steel-reinforced concrete bridges and highways exposed to deicing salts
- Concrete in or near marine environments
- Parking garages
- Piers, piles, and concrete dock structures

Benefits:
Sika® FerroGard®-901 offers owners, specifiers, port authorities, DOT s, and engineers a proven technology in corrosion inhibition that is easily added to ready-mix or precast concrete. This dual action inhibitor dramatically delays the initiation of corrosion and greatly reduces the overall corrosion activity.

- Extends the service life of concrete structures and reduces maintenance costs.
- Provides corrosion inhibition in the presence of varying chloride concentrations, even high concentration of deicing or marine salts.
- Does not affect the rheological properties of plastic concrete: no changes in mix design or placement operations are required.
- Does not affect the properties of hardened concrete, such as compressive strengths, permeability, etc.
- Sika® FerroGard®-901 is neutral to hydrogen embrittlement of prestressed steel i.e. it neither enhances nor limits hydrogen embrittlement of prestressing steel.

Application Instructions

Mixing
Sika® FerroGard®-901 is mixed with the gauging water or added at the same time into the concrete mixer. It may also be added to the concrete in the transit mixer at the point of discharge. In this case, an additional mixing time of at least 1 minute per m3 concrete must be observed. Before discharging it, check the concrete visually for uniform consistency. The quantity of Sika® FerroGard®-901 in the mix design should be taken into consideration when determining the quantity of water for a specific W/C ratio. Sika® FerroGard®-901 is not to be mixed with dry cement.
Sika Solutions for Every Construction

Concrete  
Waterproofing  
Refurbishment

Flooring  
Sealing & Bonding  
Roofing

SIKA - THE CUSTOMISED SOLUTION PROVIDER

Sika’s innovative ideas and expertise in evolving quality products has been a hallmark in the history of construction chemicals. From hundred years Sika is consistently serving the construction industry with its pioneering technology and commitment.