Protectosil®
Corrosion protection for steel reinforced concrete

Protectosil®

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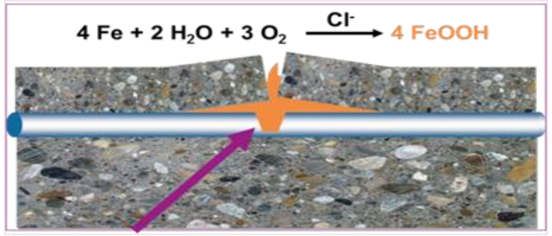
Leading Beyond Chemistry

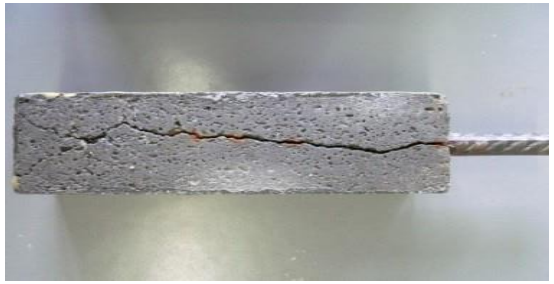
Content

- **Description technical issue and impact**
- Product application & finder matrix
- Application methods & unique test capability
- Performance data

Technical issue:
Why steel in concrete corrodes and why this is a problem



Chloride ions (from deicer salts or salt water) migrate to the concrete steel reinforcement, once a critical concentration is reached only oxygen and water is needed to sustain the corrosion of the steel



As steel corrodes iron turns into iron oxide or rust. The rust takes up to four times the volume as the steel, putting pressure on the concrete, causing cracking and spalling

Corrosion also dissolves the steel which results in a loss of structural strength

Protectosil® can help

Cost factors and impact caused by deteriorated bridges

Economic costs

- **High costs of new structures or repair**
- **Economic costs during construction work**
  - Traffic jam, speed reduction, limited traffic weight of trucks, alternative or blocked routes causes time loss for logistics and paralyze local economy

Ecological costs

- Significant environment and noise pollution, increased CO_2 emission, overloaded alternative routes at surrounded area

Social costs

- Stress for commuter and residents

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Protectosil® protects steel reinforcement against chloride induced corrosion pitting in order to secure long service life and safe maintenance efforts

Structure owner get long term durability and usage along with significant cost savings in terms of maintenance efforts

Features *"What do we offer?"*

Protectosil® grades ***passivates*** the ***rebar*** in the concrete and prevents that ***chlorides*** interact with the rebar.

Benefits *"Why should customer care?"*

There will be ***no further corrosion*** which will damage the structure in order to prolong ***durability and service life***

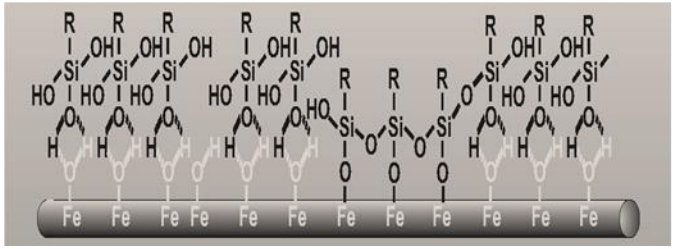
Value *"What is that worth?"*

No need for expensive repairs for a very long time which ***reduce*** significantly the ***maintenance costs*** for the owner and keep functionality of relevant construction

How does Protectosil® corrosion protection work?

- **Protectosil®** molecules react with the concrete pore walls
  ⇒ regress of water, chloride ions and other pollutants
  increase of the electrical resistance

- **Protectosil®** molecules react with the oxide layer of the rebar
  ⇒ strengthening of the passivation layer
  increase of overvoltage



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Product recommendation

Corrosion protection – Product finder

	Protectosil® grade	Application / kind of usage		Concrete structure / building		Maintenance & repair			
		Surface applied	Part of mix design	Existing constructions	New constructions	Dense concrete	Porous concrete	Hydrophobic concrete	Mortar
Pure silane systems	**CIT**	✓		✓	✓	✓	✓	✓	
Powder form	**DRY CIT**		✓		✓				✓
Water based	**WA CIT**		✓		✓				✓

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Application methods and key measures

Application methods

Surface application

- Preferred for maintenance efforts at existing structures

Part of mix design

- Suitable for every product
- Amount can be optimized according to performance benchmark

Factors for success

- Test patch to check penetration properties of substrate
- Application of recommended amount irregardless on number of necessary layers
- Protocol and monitoring of applied amount

Key measures

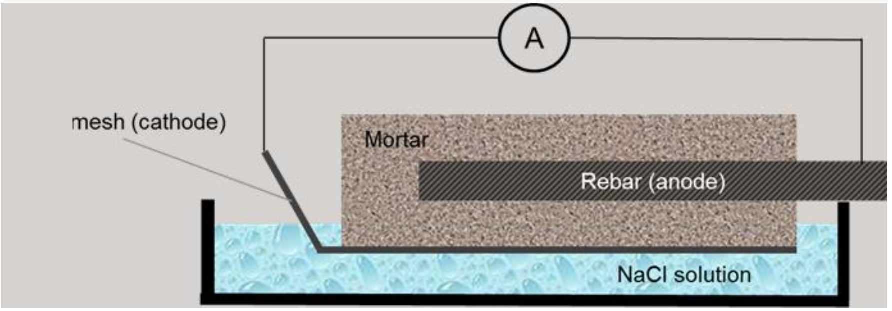
Unique customer support

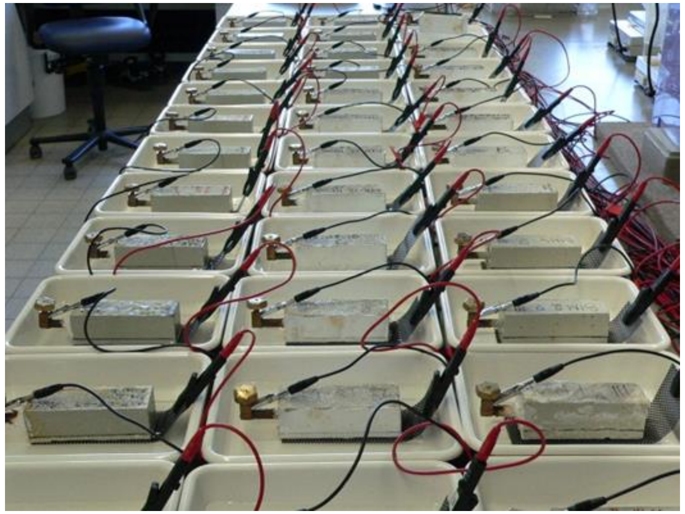
- In House “Lollipop test” to find necessary dosage to satisfy customer defined product requirements

Unique in-house corrosion test:
enables in-situ investigation of corrosion activities

A “lollypop” test method was developed based on the SGK* test setup to determine corrosion activity inside specimen:

A steel rebar is fixed in the center of a mortar sample. After curing of the mortar, the specimen is placed onto a resistant mesh and immersed into a 1 M NaCl solution as depicted below.





The electrical circuit is closed via a cable connecting the rebar (anode) to device monitoring corrosion current and calculated according to Faraday´s law into dissolved iron amount.

*Schweizerische Gesellschaft für Korrosionsschutz

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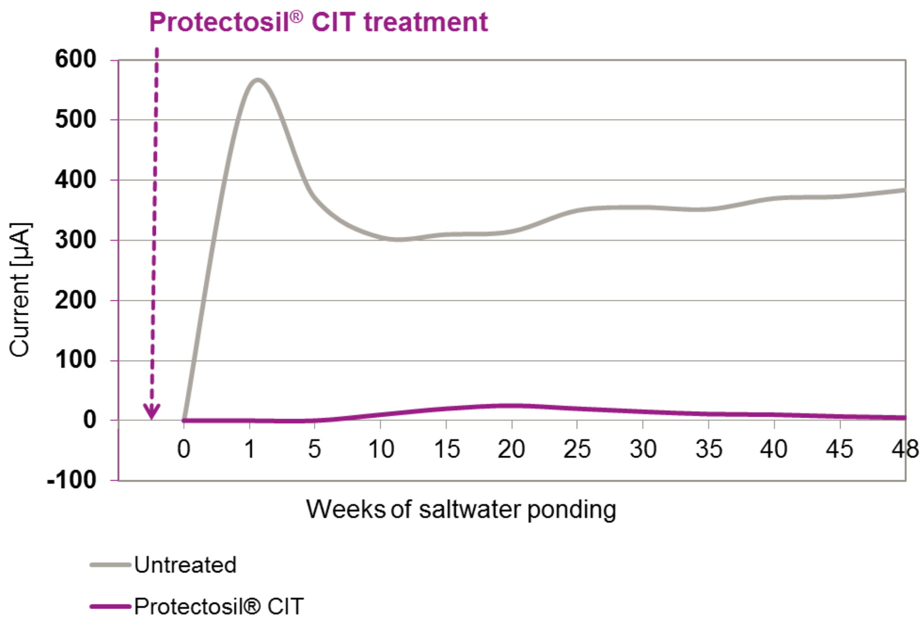
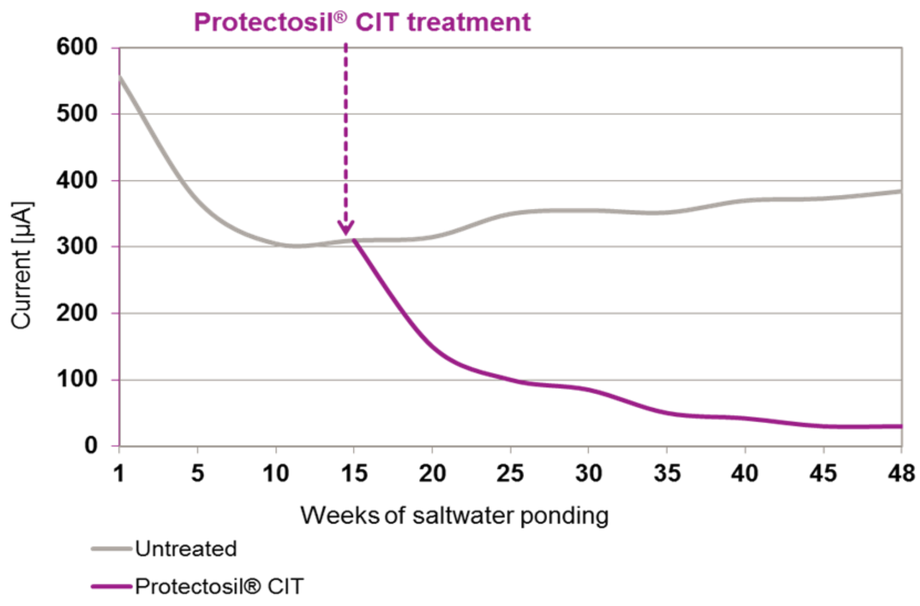
Surface applied:
Protectosil® CIT protects new and even existing structures

New concrete structures



Initial treatment prevents corrosion activity

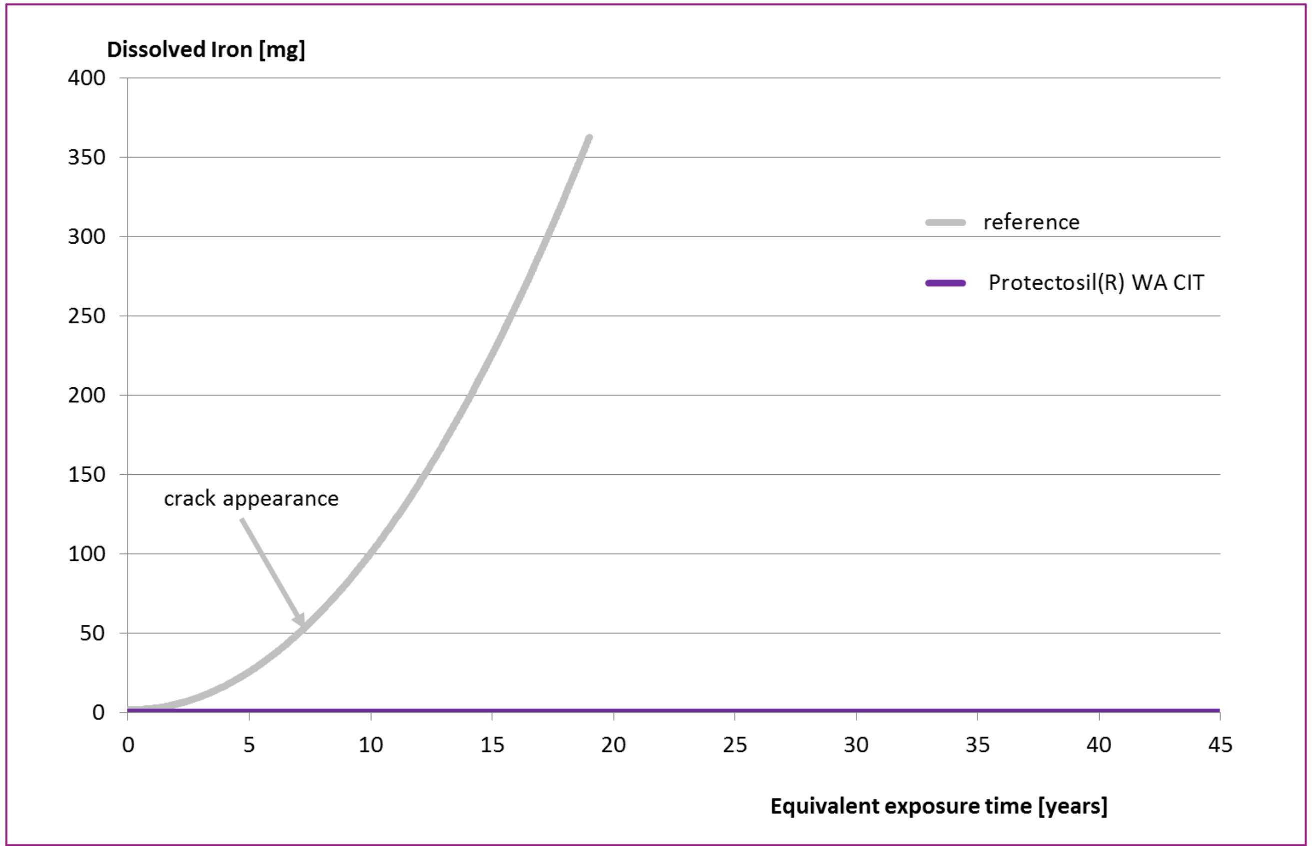
Existing structures with corrosion activity



Treatment stops initiated corrosion activity and keeps damage on hold

Data taken form Wiss, Janney, Elstner, Ass Inc. Testreport 960896

Part of mix design:
Protectosil® grades provide durable and long term protection



Even after an equivalent exposure time of 45 years, samples protected with Protectosil® show no corrosion activity or damage

Interims results after 90 cycles, respectively 45 years in the field :

Reference:

- cracked after 15th cycles (7-8 years in the field).

Protectosil® WA CIT
(1,0 wt% on cement)

- No corrosion activity
- No cracks
- Test ongoing

Advantages of Protectosil® mass modification versus competing systems

Corrosion protection systems	Easy handling	Long term effectiveness	Long term cost for application and maintenance *
Dense concrete	+	−	−
Stainless steel	+	+	−
Cathodic protection	−	+	−
Corrosion inhibitors (Ca-nitrites, amino ethanols, phosphates, etc.…)	+	−	−
Protectosil® DRY CIT or WA CIT	+	+	+

* time frame of 30 years

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