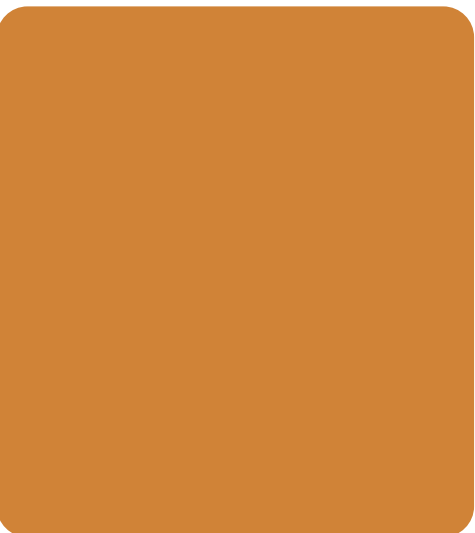
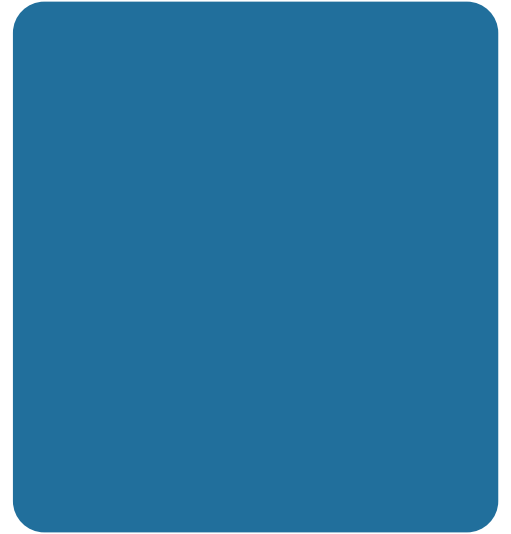


# RUST-X <sup>TM</sup>

**CONCRETE CORROSION INHIBITORS**





# Corrosion Problem in Concrete

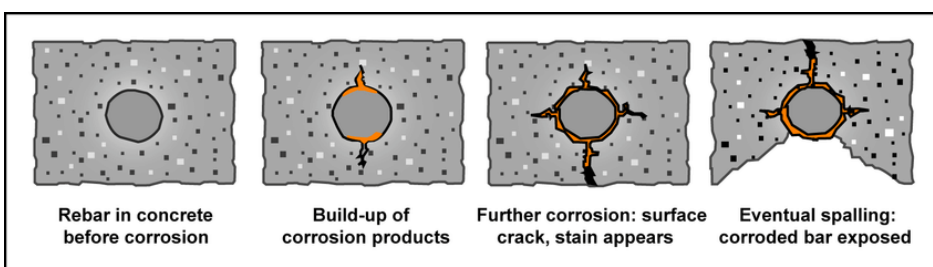


Corrosion in rebar is the most common cause of failure in buildings, bridges, tunnels & structures. RUST-X CCI's are effective in increasing the service life of the concrete structures by reducing the corrosion rate of rebar in the concrete.

In case of the concrete structures, the sand, the salts present in the sand as well as the water in the concrete entering due to porosity play an important role in causing corrosion of the rebar.

The corrosion rate is higher in aggressive environments in the coastal areas as well as for constructions under water or underground such as bridges or tunnel and lead to cracking and failing of structures.

The CCI's play an important role in drastically reducing the corrosion rate by migrating towards the metal surface, forming a layer on the metal surface as well as preventing corrosion due to anodic/cathodic inhibition therefore extending the service life of the constructed bridges, buildings, roadways as well as tunnels.





# Concrete Corrosion Inhibiting Products

## **CCI 4204**

**Concrete Corrosion Inhibiting Liquid for in-service infrastructure corrosion protection to reduce corrosion rate, spalling etc.**

## **CCI 4206**

**Concrete Corrosion Inhibitors for submerged structures, tunnels, infrastructure in wet environments, snow capped areas, saline exposure etc.**

## **CCI 4207**

**Concrete Corrosion Inhibiting Powder for Admixtures for Bridges, Flyovers, Roads and Buildings**

## **CCI 4208**

**Concrete Corrosion Inhibitors based upon food approved additives for addition in water tanks, concrete pipelines etc.**



# CCI 4204 Migratory Corrosion Inhibiting Liquid for In Service Infrastructure

RUST-X CCI's are Concrete Corrosion Inhibitors having volatility and migratory effect with affinity for metal and protect it from corrosion

Many bridges, buildings and road networks have not been treated with corrosion inhibiting chemicals at the time of construction. The exposure to water and chlorides exposes the concrete to corrosion and deterioration of the rebar. As the corrosion occurs, the oxides of iron occupy greater space compared to the rebar and cause stresses within the concrete. It also loosens the concrete rebar bond and causes cracking of the concrete around the rebar. This deterioration may be happening at a much higher rate for the un-inhibited structures where the corrosion inhibiting additives have not been incorporated into the admixtures.

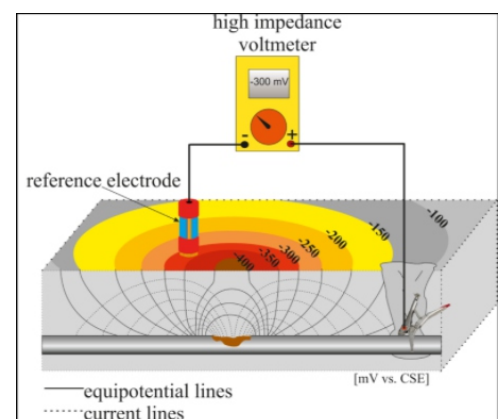
This could be occurring in under use buildings, bridges and roads etc. RUST-X CCI 4204 is a liquid applied corrosion inhibitor by spray or brush which gets adsorbed into the concrete and migrates towards the rebar. The application of the CCI 4204 immediately results in the reduction of the electron flow rate and hence corrosion of the rebar within the concrete.

The effect can be verified by measuring the half cell potential of the concrete and measuring the electron flow. The CCI 4204 can be sprayed on the existing structures and due to capillary absorption action it flows inwards into the concrete. The liquid has a high affinity towards the iron rebar and forms a coat over the rebar which stays for a long period and provides excellent protection to the rebar.

A half cell potential can be measured over time and the 4204 re-applied as the effect begins to reduce.



Current Measurement Using Half Cell Potential system for concrete





# CCI 4206 Concrete Admixture Additive for Submerged Structures in Saline Water

The rate of rebar corrosion on submerged structures in water or sea water drastically increases due to continuous exposure to dampness and wet concrete around the rebar.

The CCI 4206 can be mixed at 1-2% with concrete to provide excellent corrosion inhibitory effect. The presence of the CCI 4206 molecules within the concrete make it highly corrosion inhibiting reducing the oxidation rate by 80-90% and hence increasing the life of the building from 5 - 10 times. The crack propagation in concrete is drastically reduced.

The effect of corrosion inhibition is highly beneficial in coastal areas, rainy places where buildings remain damp all the time as well as in places having high humidity or having high salt content in soil and sand.

Figure 1 shows the metal weight loss or corrosion loss of steel rebar in salt water during an immersion test in salt water

Figure 2 shows the corrosion rate of steel rebar in salt water.

The dosage recommended is 20 kg per m<sup>3</sup> of the admixture for normal environments and 40 kg/m<sup>3</sup> for aggressive saline environments.

The addition of the CCI 4206 does not have any detrimental effect on the setting time or compressive strength of the cement.

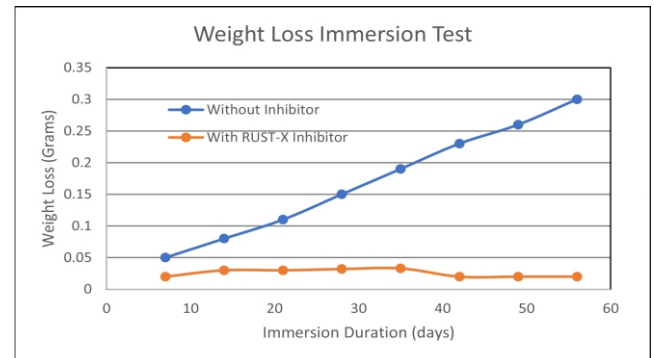


Figure 1 Metal Weight Loss of steel rebar in salt water during an immersion test in salt water

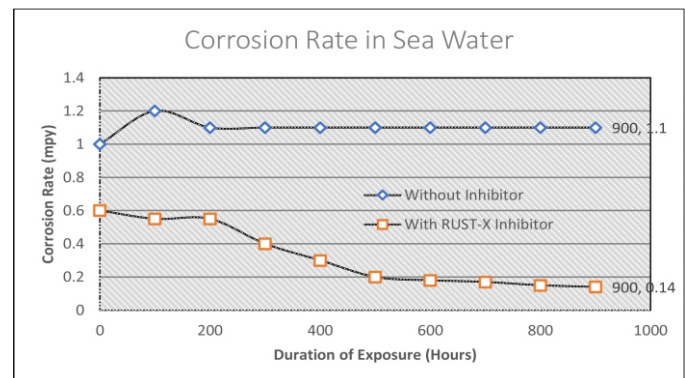


Figure 2 shows the rate of corrosion of steel rebar in salt water.



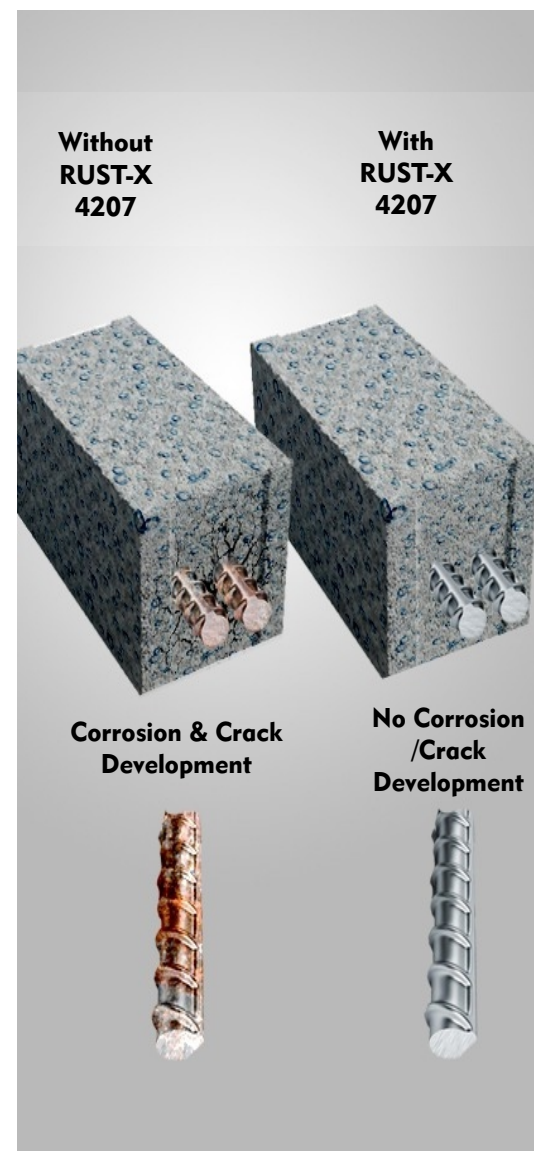
# CCI 4207 Migratory Corrosion Inhibiting Powder for Concrete Admixtures Roads - Bridges - Flyovers

RUST-X CCI's are Concrete Corrosion Inhibitors having volatility and migratory effect with affinity for metal and protect it from corrosion

Roads, bridges & flyovers are the basic necessities for the growth and development of any nation. A very high amount of investment and manpower goes in the establishment of such infrastructure. The rate of corrosion is one of the major factor that determines the life of the infrastructure. As the corrosion grows on rebar the bond between the concrete and the rebar is reduced. so do the cracks in the concrete which results in wearing off of the roads.

The corrosion rate of rebar is different in different environmental conditions. Coastal areas, hot and humid areas as well as areas under constant rainfall and snow may have higher corrosion rates. As a vehicle passes over the wet road, the tyres push the water droplets into the concrete. In case of chlorides present on the road due to coastal rain or from the snow melting pellets, these chloride molecules also penetrate as well as get pushed inside the concrete of the road.

The corrosion rate of the rebar increases due to presence of water and salts. RUST-X CCI 4207 powder is an excellent corrosion inhibitor which can be mixed with the concrete during the construction. The inhibitor is a mixed inhibitor with multimodal action of contact, in-situ as well as migratory corrosion inhibitor where the inhibitor has the power to evaporate and reach metal due to its affinity towards metal surface.





# Tests Conducted on suitability of CCI 4207 in admixtures



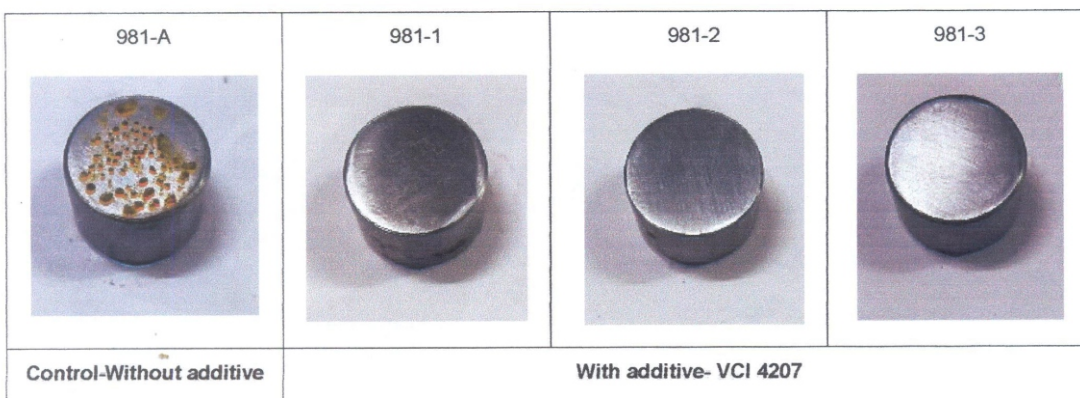
## JIS 1535 - Test to confirm ability of the CCI 4207 to travel towards metal and protect it from corrosion

### Test Procedure:

5 grams of CCI 4207 powder is placed at the bottom of a conical flask. The metal samples are suspended with the cork of the flask away from the powder. The flasks are placed at 23°C for 20 hours after which Glycerol/Water mixture are added at the bottom of the flask. The flask is heated to 40°C for 2 hours after which the metal samples are taken out and observed for corrosion. The CCI 4207 is said to pass the test if the metal samples with powder at the bottom of the flask do not develop corrosion whereas the one without any powder develops full corrosion after the test.

### Inference of the test result:

The successful test confirms that even if the powder is not in direct contact with the metal, it has ability to evaporate or migrate and protect the metal from corrosion in real life conditions during use. As the concrete gets wet, the water in the pores of the concrete works as an electrolyte and the CCI 4207 dissolves itself in the water. This presence of dissolved molecules of CCI 4207 prevent water from causing corrosion due to the cathodic/anodic inhibition of the CCI powder.



## Tests Conducted for suitability of CCI 4207 in admixtures

IS 516 -1959 - Test to confirm no detrimental effect on the compressive strength after at 3, 7 and 28 days

IS 516-1959 deals with the testing of concrete for compressive strength of the concrete after 3 days, 7 days and 28 days. The tested inhibitor CCI 4207 with the admixture showed no detrimental effect on the compressive strength after 28 days of curing. The average compressive strength at 3, 7 and 28 days was above the recommended minimum strength as per the standard for M35 tested specimen.

		3 Days	7 Days	28 Days
Average Compressive Strength (N/mm <sup>2</sup> )	Minimum Specification	14	23.5	35
	Control	25.8	34.1	44.3
	With Corrosion Inhibitor	23.4	32.2	45.6

Tested as per IS 1199 for Workability of the admixture at initial and 30 minutes

		Initial	30 minutes
Workability (Slump flow/Slump) mm	Control	180	60
	With Corrosion Inhibitor	210	85

\* Refer to complete test reports attached





**Test Report**

Report No.: 168  
ULR-TC6362210000000156F – Chemical – Building Materials

Date: 09.02.2021

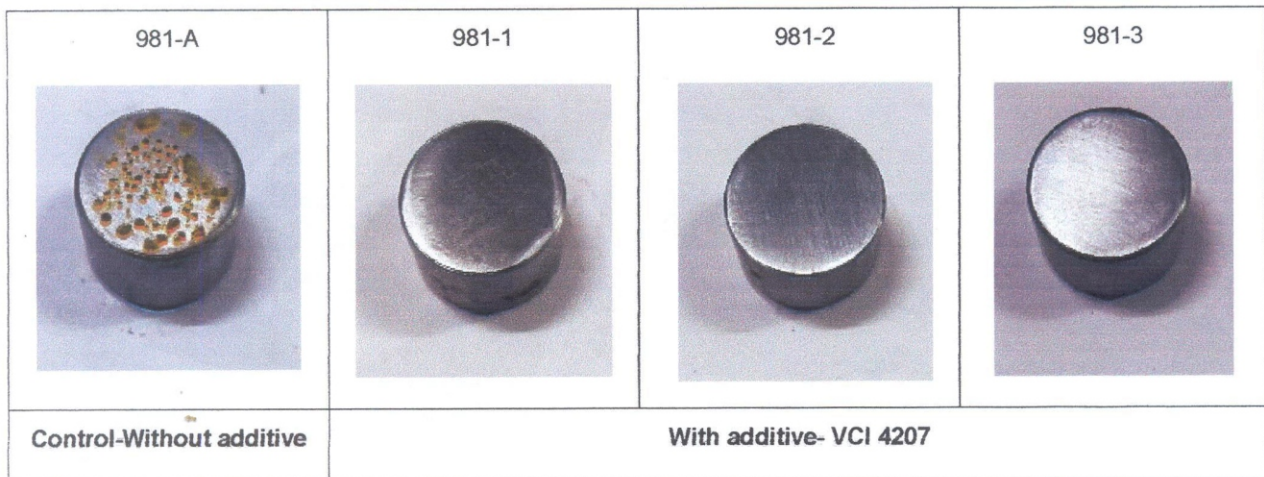
Invoice No.: G-315

Customer : Hi-Tech International  
Sample Description : Corrosion Inhibitor (Powder form)  
Customer's Reference : Letter dated-02.02.2021  
Customer id : VCI 4207  
e-cube id : 981  
Sample Condition : Satisfactory  
Test witnessed by : None

Date of Receipt: 02.02.2021  
Period of Testing: 08.02.2021 to 09.02.2021

**Modified Accelerated Corrosion Test (Method – JIS Z 1535)**

e-cube ID	Sample ID	Observations
981-A	Control- Without additive	Excessive corrosion spots
981-1	With additive	No corrosion
981-2	With additive	No corrosion
981-3	With additive	No corrosion



**Notes:**

1. Test results indicated above for the sample submitted by the client.
2. Test results may not be reproduced in part without the written permission of e-cube concrete consultants LLP.
3. We do not undertake any responsibility for any involvement in any type of litigation arising out of this report submitted by e-cube concrete consultants LLP.



For e-cube concrete consultants LLP

*Bhagyashree Katkar Wani*  
Bhagyashree Katkar · Wani  
Authorized Signatory

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TC - 6362



## Test Report

Report No.: 467

Date: March 18, 2021

Invoice No. G-

ULR-TC636221000000443P - Mechanical - Building Materials

Customer : Hi-Tech International  
 Sample Description : Corrosion Inhibitor (Powder form)  
 Customer's Reference : Letter dated-02.02.2021  
 Customer id : VCI 4207  
 e-cube id : 1129  
 Sample Condition : Satisfactory  
 Test witnessed by : None

Date of Receipt: 02.02.2021

Period of Testing: 12.02.2021-12.03.2021

## Mix Proportions - M-35:

Ingredient	Cement	C.S.S	10mm	20mm	Water	Admixture	
						Source	
Source	UT OPC 53	Local	Local	Local	TMC	Mapei SX 542	Hi-Tech International
ecube-ID	480	INV-230	INV-231	INV-232	NA	INV-233	1129
Qty (kg/m <sup>3</sup> )	440	745	558	650	170	2.2	0
	440	745	558	650	170	2.2	0.2

## Reference Code: IS 1199

		Initial	30 Mints
Workability (Slump Flow / Slump) mm	Control	180	60
	With Corrosion Inhibitor	210	85

## Reference Code: IS 516-1959 (reaffirmed 2004)

		3 Days	7 Days	28 Days
Average Compressive strength (N/mm <sup>2</sup> )	Control	25.8	34.1	44.3
	With Corrosion Inhibitor	23.4	32.2	45.6

Remarks on test method: Nil.

Notes:-

- The above recommendations are based on the fine aggregates & coarse aggregates are at saturated surface dry conditions. At the time of concrete production, adjustments are required to be made for surface moisture or water absorption in the fine & coarse aggregates, as applicable.
- Test results may not be reproduced in part without the written permission of e-cube concrete consultants LLP.
- We do not undertake any responsibility for any involvement in any type of litigation arising out of this report submitted by e-cube concrete consultants LLP.



For e-cube concrete consultants LLP

Bhagyashree Katkar-Wani

Bhagyashree Katkar - Wani  
Authorized Signatory

BNK/SSD/SK

Page 1 of 1

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TC - 6362





## Test Report

Report No.: 612

Date: 08.04.2021

Invoice No.: G-459

Customer : Hi-Tech International

Sample Description : Corrosion Inhibitor (Powder form)

Customer's Reference : Letter dated-02.02.2021

Customer id : VCI 4207

e-cube id : 1129

Sample Condition : Satisfactory

Test witnessed by : None

Date of Receipt: 10.02.2021

Period of Testing: 06.03.2021 to 05.04.2021

**Evaluating Corrosion Test: ASTM G1-03**

Sample Size : Nominal Length -40mm, Nominal Diameter-10mm

**Cleaning method:** Clark solution is prepared by dissolving 20 g of Antimony Trioxide & 50 g of Stannous Chloride in 1000 ml concentrated Hydrochloric acid, S.G. 1.18. After complete removal of corrosion products (5 minutes approximate), take out test pieces & wash in running water & finally with distilled water. Then wash the test pieces, with Acetone.

e-cube no	Initial weight (g)	Final weight (g)	Weight loss (g)	Area (cm <sup>2</sup> )	Corrosion rate (mills per year)	Average (mills per year)
Control-1	23.837	23.755	0.082	0.777	0.064	0.063
Control -2	23.413	23.328	0.085	0.771	0.067	
Control-3	24.031	23.958	0.073	0.777	0.057	
1129-1	24.717	24.673	0.044	0.777	0.035	0.038
1129-2	24.977	24.931	0.046	0.780	0.036	
1129-3	24.459	24.405	0.054	0.767	0.043	

**Notes:**

- 1 Test results indicated above for the sample submitted by the client.
- 2 Test results may not be reproduced in part without the written permission of e-cube Concrete Consultants LLP.
- 3 We do not undertake any responsibility for any involvement in any type of litigation arising out of this report submitted e-cube Concrete Consultants LLP.

For e-cube Concrete Consultants LLP



Authorized Signatory

Suhas S Dhuri

**e-cube concrete consultants LLP**

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# RUST-X USA

# RUST-X <sup>TM</sup>

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