TB-0906 — DCI® Dosage Rates and ACI Guidelines

Corrosion is an electrochemical reaction similar to the process that takes place inside a battery. In reinforced concrete, the rebar acts as electrodes and the salt laden water as the electrolyte.

Many factors affect how quickly corrosion in concrete may begin. In unprotected concrete the most important factors are the chloride loading rate (from deicing salts or a marine environment) and the concrete quality. Concrete quality is extremely important. So much so, that the American Concrete Institute (ACI) has set guidelines to help designers and contractors combat this problem. The better the quality of the concrete, the longer it will take before the chlorides reach the rebar and thus, before corrosion begins. Some of the parameters which effect concrete quality are cement factor, type of cement, watercement ratio, concrete cover over the reinforcing steel, local materials used, placement of the concrete, finishing and curing techniques and even the structural design.

Since the chloride loading rate and final concrete quality are unknown factors, we cannot guarantee the longevity of the protection offered by DCI®. Quality concrete as recommended by ACI will slow the ingress of chlorides into the concrete while DCI® will significantly reduce the corrosion rate once the chlorides reach the rebar. Neither quality concrete nor DCI® will stop corrosion forever but both will retard the onset of corrosion.

DCI® corrosion inhibitor is a calcium nitrite based liquid which chemically controls the corrosive action of chloride salts. It is added to a concrete mix during the batching process or at the job site and disperses uniformly through the concrete. Once the concrete is placed, DCI® stabilizes the passivating layer of oxide normally found on the reinforcing steel in concrete. This significantly reduces the corrosion rate by making it more difficult for chlorides to penetrate the passivating layer.

DCI® may be added at various dosage rates to protect against different levels of chlorides. A determination of the amount of chloride protection required for the project should first be made and then a DCI® dosage rate chosen from Table I to protect against this amount. The degree of corrosion protection provided depends not only on the amount of DCI® used but also upon the basic concrete quality. For this reason GCP Applied Technologies recommends a systems approach to corrosion protection of quality concrete and DCI® corrosion inhibitor. It is suggested that at least the minimum requirements for quality concrete based on ACI guidelines be followed. Some of these requirements are listed here, although ACI should be consulted for more details.

DCI® Dosage Rates vs Chloride Protection			
DCI®		Chloride	
L/m^3	(gal/yd^3)	kg/m^3	(lbs/yd^3)
10.0	2	3.6	6.0
12.5	2.5	4.8	8.0
15.0	3	5.9	9.9
17.5	3.5	6.8	11.5

20.0	4	7.7	13.0
22.5	4.5	8.4	14.1
25.0	5	8.9	15.0
27.5	5.5	9.3	15.6
30.0	6	9.5	16.0

ACI 318 "Building Code Requirements for Reinforced Concrete"

Maximum water-cement ratio – Table 4.2.2

- For corrosion protection for exposure to deicing salts, brackish water, seawater 0.40

Minimum concrete protection (cover) for reinforcement – Section 7.7

- Concrete exposed to weather 38 mm to 50 mm (1.5 in. to 2 in.)

Commentary Section 7.7.5 – corrosive environments cast-in place:

- 50 mm (2 in.) walls and slabs
- 65 mm (2.5 in.) other members

Prestressed:

- 38 mm (1.5 in.) walls and slabs
- 50 mm (2 in.) other members

Note: DCI® concrete requires a minimum cover of 19 mm (0.75 in.) greater than the maximum aggregate size.

Total air content for frostresistant concrete – Table 4.2.1

- For 19 mm (0.75 in.) aggregate, severe exposure 6%

Note: For DCI® concrete a minimum of 5.5% is required. Where ACI recommends a higher minimum air content, it should be adhered to.

Curing – Section 5.11 Maximum chloride ion content for corrosion protection – Table 4.4.1

ACI 357 "Guide for the Design and Construction of Fixed Offshore Concrete Structures"

Maximum water-cement ratio – Table 2.1

- Splash zone: 0.40

Minimum concrete cover of reinforcement – Table 2.2 splash zone:

- 65 mm (2.5 in.) or reinforcing steel
- 90 mm (3.5 in.) for posttension

Cover of stirrups:

- 13 mm (0.5 in.) less than above

Note: DCI® concrete requires a minimum cover of 44.5 mm (1.75 in.) greater than the maximum aggregate size.

Air content for freeze-thaw durability – Section 2.8.4

- For 19 mm (0.75 in.) aggregate, severe exposure 6%

Note: For DCI® concrete a minimum of 5.5% is required. Where ACI recommends a higher minimum air content, it should be adhered to.

Curing of Concrete – Section 6.5

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gcpat.com/solutions/products/dci-corrosion-inhibitor/tb-0906-dci-dosage-rates-and-aci-guidelines