

Discussion of Testing for Certi-Vex Penseal CT

Testing the effectiveness of surface applied corrosion inhibitors either as a primary application or blended with silane water repellents has been done using FHWA RD-98-153 protocol. This testing protocol is used for evaluating the protection of new reinforced concrete construction where there is no active corrosion on reinforcing steel at the beginning of the testing process. Certi-Vex Penseal CT demonstrates exceptional performance under this testing regimen dramatically reducing the corrosion potential.

Competitive marketing efforts to further demonstrate the efficacy of various products for reduction of advanced corrosion has resulted in reporting of a number of testing protocols that are not included in any ASTM Methods. This lack of uniform testing protocols allows for interpretation of the data as desired by the manufacturer. The absence of standardized testing also calls into question the reproducibility of the data. It should be stated that chemically, existing corrosion of rebar in concrete cannot be reversed but the rate of future corrosion activity can be reduced.

Exposure of reinforced concrete to chloride ions is the primary cause of premature corrosion of steel reinforcement. Chlorides from deicing salts and marine environments penetrate the concrete's surface and through cracks. Internal sources of chlorides include admixtures, aggregates and mixing water. In addition the permeability of the concrete will affect the rate at which the chloride ions diffuse through the concrete. Once the chloride exceeds the threshold value in the concrete the reinforcing steel becomes "depassivated" and corrosion begins. Therefore, by reducing chloride ions the rate of corrosion is reduced.

Vexcon has evaluated the available ASTM standards for determining the effects of chloride ion intrusion in concrete and has selected ASTM C1202, *Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration* as a method to demonstrate that Certi-Vex Penseal CT provides long term dual protection by preventing water and chloride ion penetration and reduction in the rate of corrosion when the onset of corrosion has begun.

ASTM C1202 uses measurement of the conductivity of a concrete cylinder under standardized conditions as a correlate of the chloride permeability of the material. The electrical current passing through a 50mm thick slice of a 100mm diameter cylinder with one face immersed in a sodium chloride solution and the opposite face in sodium hydroxide solution with an applied driving force of 60 volts is monitored for a period of 6 hours. The total charge passed, in coulombs, has been found to be related to the resistance of the specimen to chloride ion penetration.

ASTM C1202 develops a base line of chloride ion penetration-by treating job site cylinders of normal 4000PSI concrete with Certi-Vex Penseal CT. After treating with 3% NaCl (sodium chloride) solution the level of chlorides is determined by passing an electrical charge through the specimen and is reported in coulombs. The cylinders are dried and the ends of the tested samples are coated with Certi-Vex Penseal CT and placed back into the testing regimen. Again, an electrical charge is passed through the specimen reported in coulombs. The following data reported by independent testing demonstrates the effectiveness of Certi-Vex Penseal CT at reducing chloride ion.

Coulombs before coating	Coulombs after coating	Chloride ion reduction
1463	443	70%

The application of Certi-Vex Penseal CT to existing concrete with corrosion of reinforcement steel will prevent additional water and chloride penetration. It will also provide a corrosion inhibiting material on the steel which will reduce the rate of additional electrical conductivity as measured by reduced coulombs by the electron movement and the migration of chloride ion thereby reducing the rate of corrosion activity. See the FHWA-RD-98 section of data sheet Certi-Vex Penseal CT PS135 for the reduction of corrosion activity and chloride ion reduction as measured by ASTM G-109, ASTM C-876, and ASTM 1152. Concrete with heavy corrosion, other repair and restoration protocols must be used to remove the corrosion.