NACE SP0216-2016
Item No. 21403

Standard Practice

Sacrificial Cathodic Protection of Reinforcing Steel in Atmospherically Exposed Concrete Structures

Approved 2016-03-31
NACE International
15835 Park Ten Place
Houston, Texas 77084-5145
+1 281-228-6200

ISBN 1-57590-331-8

Foreword

This NACE International standard practice presents guidelines for sacrificial (galvanic) cathodic protection (SACP) of reinforcing steel in atmospherically exposed concrete elements or structures. These guidelines target owners, engineers, architects and contractors, and those concerned with mitigation of reinforced concrete corrosion through the application of SACP systems.

The information in this standard, as it relates to SACP systems, is intended for atmospherically exposed concrete structures and is not applicable to concrete with nonferrous reinforcement, epoxy-coated, galvanized, or other types of coated reinforcement. SACP has been successfully applied to buried and submerged reinforced concrete structures; however, these applications are not addressed in this standard.

TG 047 is comprised of corrosion consultants, consulting architects and engineers, material manufacturers and suppliers, cathodic protection engineers, metallurgical engineers, researchers, structure owners, contractors, and representatives from both industry and government.

For more information on the various SACP systems that are commercially available, refer to NACE Publication 01105.[1]

This standard was prepared in 2016 by Task Group (TG) 047 “Reinforced Concrete: Sacrificial Cathodic Protection of Reinforced Concrete Elements.” TG 047 is administered by Specific Technology Group (STG) 01, “Reinforced Concrete; “and is sponsored by STG 05, “Cathodic/Anodic Protection.” This standard is issued by NACE under the auspices of STG 01.

In NACE standards, the terms *shall, must*, *should,* and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual.* The terms *shall* and *must* are used to state a requirement, and are considered mandatory. The term *should* is used to state something good and is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.

NACE International
Standard Practice

Sacrificial Cathodic Protection of Reinforcing Steel in Atmospherically Exposed Concrete Structures

Contents

Section 1: General

1.1 Background

1.1.1 The corrosion reaction between a metal and its environment is an electrochemical cell. An electrochemical cell consists of four components: an anode, where oxidation occurs; a cathode, where reduction occurs; a metallic path, where current flows; and an electrolyte (concrete), where ion transfer occur in a shared environment. If any one of the four elements of the electrochemical cell is eliminated, corrosion cannot occur. The anodic and cathodic areas can occur, for example, as a result of exposure to differential environmental conditions or coupling dissimilar metals.

1.1.2 Reinforcing steel is compatible with concrete because of their similar coefficients of thermal expansion and because concrete generally provides the steel with corrosion protection. Corrosion protection is the result of the highly alkaline portland cement that allows a stable, passivating film to form on the surface of the reinforcing steel. This film naturally protects the steel until the film is affected. Mechanisms that affect the protective film and lead to corrosion include carbonation and other mechanisms that reduce the pH of the concrete and contamination of the concrete by chlorides, and other halides and chemicals that are corrosive to reinforcing steels. Carbonation results from atmospheric carbon dioxide diffusing through concrete and decreasing the alkalinity of concrete. Chloride contamination also affects the passive film. Chlorides can be cast in concrete or penetrate concrete from external sources such as seawater, deicing salts, or other chemicals.

1.2 Sacrificial Cathodic Protection (SACP)

1.2.1 The basic principles of corrosion can be used to understand the theory of SACP. SACP is defined as a technique to mitigate corrosion of a metal by making it the cathode in a corrosion cell via the introduction of a metal that is more electrochemically active in that environment than the metal to be protected.

1.3 Scope and Limitations

1.3.1 The provisions of this standard shall be applied under the direction of a registered professional engineer, or a person certified by NACE as a corrosion specialist or cathodic protection specialist. The professional's qualifications should include suitable experience in cathodic protection of reinforced concrete structures. Under certain circumstances, a cathodic protection system may either become a structural component or significantly affect the serviceability and structural performance of a reinforced concrete structure; therefore, review of such impact should be made by a structural engineer.

1.3.2 The guidelines presented here are limited to SACP on existing atmospherically exposed concrete structures. This standard applies to both conventionally reinforced concrete and prestressed reinforced concrete.

1.3.3 SACP systems require monitoring provisions to determine the performance and to comply with this standard. SACP systems used without monitoring systems or methods to measure their performance do not comply with this standard practice as their performance cannot be verified.

1.3.4 Cathodic protection is a proven technique for controlling corrosion of steel in existing structures for certain applications. However, cathodic protection neither replaces lost steel nor returns corroded reinforcement to its original diameter. Although a reinforced concrete element may appear sound by traditional inspection techniques after a SACP system is installed, it could be experiencing corrosion-related tensile stress near ruptures in localized areas. This may lead to movements, deflection, cracking, delaminations or spalls that can appear several years subsequent to the installation of the SACP system.