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Test Methods for Assessing the Susceptibility of Prestressing Steels to Hydrogen Induced SCC

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Preface

The durability of prestressed concrete structures is very much affected by the durability of the prestressing steels. Under corrosive load these high-strength materials tend to suffer hydrogen-induced stress corrosion cracking. This type of corrosion is very dangerous as it leads to fractures of the prestressing steels without prior signs of warning. Under certain conditions failures of single wires can proceed unnoticed until the residual safety factor falls below 1.0 which could result in a sudden collapse of the structure.

Since the introduction of the prestressed concrete method of construction failures of the prestressing steel have from time to time occurred as a result of this form of stress corrosion cracking and a few cases have occurred even quite recently.

To keep the risk of prestressing steel failure as low as possible it is necessary that the steels used are sufficiently resistant to the initiation and growth of hydrogen-induced cracks during transport, processing at construction sites and during service. This requirement should be proven by a suitable test method.

In this report based on the electrochemical fundamentals of stress corrosion cracking, the general requirements for such a test method are derived. The most important of these is the simulation of practical conditions with respect to electrolytic and mechanical loading parameters. The report provides an overview of the historical development of the different test methods for prestressing steel and discusses the advantages and disadvantages at the techniques that are most frequently used.

Against the background of the trend in prestressing steel development towards ever higher strength levels it is of the utmost importance that a reliable test method for the approval and control of prestressing steels exists which can prove the durability of prestressing steel as a building material and also avoid the development and introduction of steels that are unsuitable with respect to stress corrosion cracking susceptibility.

The present report will be of value for researchers, designers and users who are working in the field of prestressing steel or prestressed concrete structures, respectively.

Jürgen Mietz

Chairman of the Working Party on Corrosion of Reinforcement in Concrete

European Federation of Corrosion Publications Series Introduction

The EFC, incorporated in Belgium, was founded in 1955 with the purpose of promoting European co-operation in the fields of research into corrosion and corrosion prevention.

Membership is based upon participation by corrosion societies and committees in technical Working Parties. Member societies appoint delegates to Working Parties, whose membership is expanded by personal corresponding membership.

The activities of the Working Parties cover corrosion topics associated with inhibition, education and computer based information systems, reinforcement in concrete, microbial effects, hot gases and combustion products, environment sensitive fracture, marine environments, surface science, physico-chemical methods of measurement, the nuclear industry, the oil and gas industry, the petrochemical industry, coatings, automotive engineering and cathodic protection. Working Parties on other topics are established as required.

The Working Parties function in various ways, e.g. by preparing reports, organising symposia, conducting intensive courses and producing instructional material, including films. The activities of the Working Parties are co-ordinated, through a Science and Technology Advisory Committee, by the Scientific Secretary.

The administration of the EFC is handled by three Secretariats: DEHEMA e. V. in Germany, the Société de Chimie Industrielle in France, and The Institute of Materials, Minerals and Mining in the United Kingdom. These three Secretariats meet at the Board of Administrators of the EFC. There is an annual General Assembly at which delegates from all member societies meet to determine and approve EFC policy. News of EFC activities, forthcoming conferences, courses etc. is published in a range of accredited corrosion and certain other journals throughout Europe. More detailed descriptions of activities are given in a Newsletter prepared by the Scientific Secretary.

The output of the EFC takes various forms. Papers on particular topics, for example, reviews or results of experimental work, may be published in scientific and technical journals in one or more countries in Europe. Conference proceedings are often published by the organisation responsible for the conference.

In 1987 the, then, Institute of Metals was appointed as the official EFC publisher. Although the arrangement is non-exclusive and other routes for publication are still available, it is expected that the Working Parties of the EFC will use The Institute of Materials for publication of reports, proceedings etc. wherever possible.

The name of The Institute of Metals was changed to The Institute of Materials in 1992 and to The Institute of Materials, Minerals and Mining (IOM³) in 2002 following its merger with the Institution of Mining and Metallurgy.

The EFC Series is now published by Maney Publishing on behalf of The Institute of Materials, Minerals and Mining.

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