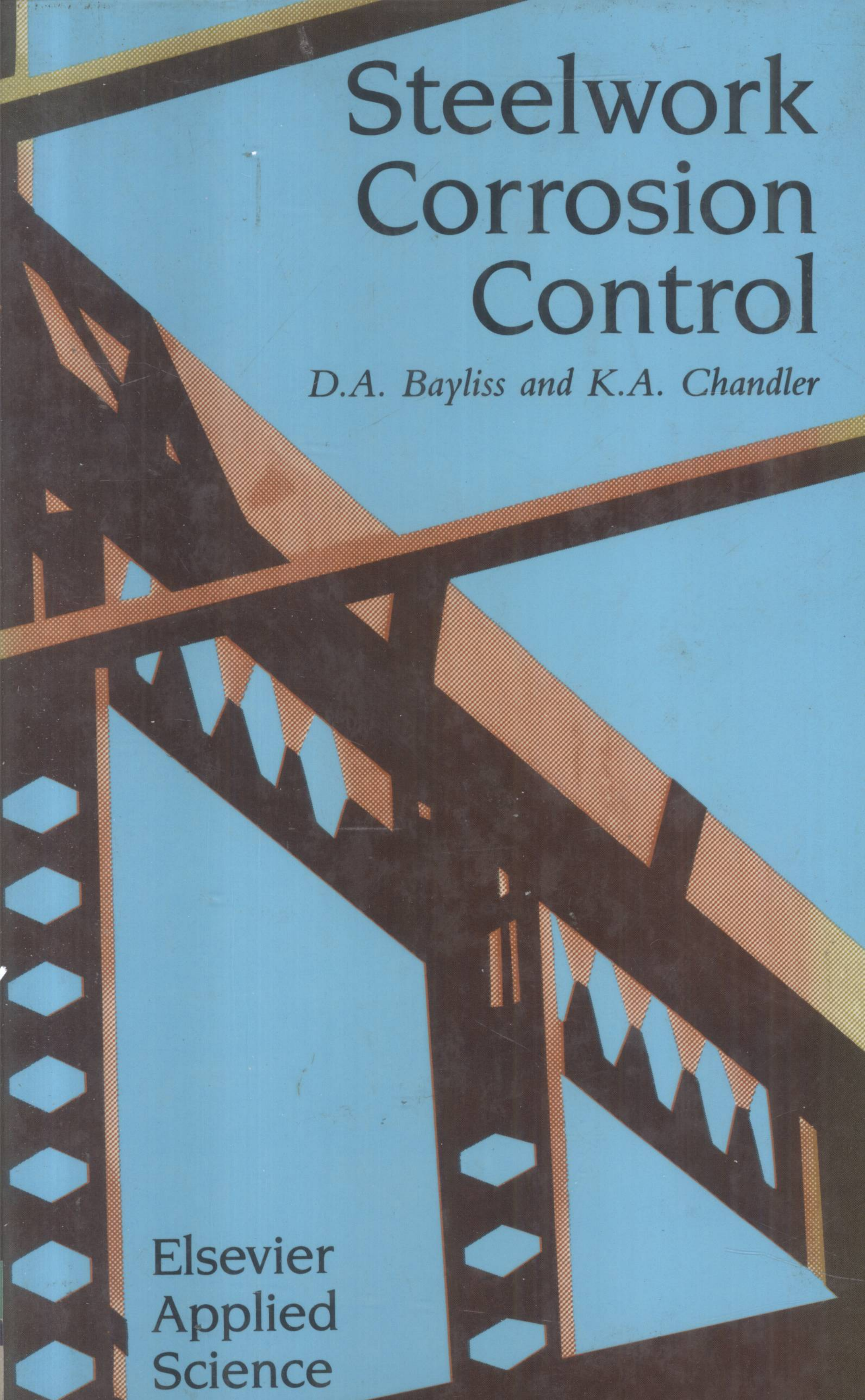
Steelwork Corrosion Control

D.A. Bayliss and K.A. Chandler



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by

D. A. Bayliss and K. A. Chandler

*Senior Consultants, I.T.I. Anti-Corrosion Ltd,
Leighton Buzzard, Bedfordshire, UK*

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Preface

This book is a comprehensive revision and updating of a similar book by the authors, published in 1985. As with the previous book, it is designed principally for engineers, architects and designers for whom the protection of structural steelwork is an important, albeit a comparatively minor, part of their total professional activities.

New materials are being developed constantly by the coatings industry and the number of standards, codes of practice and publications on corrosion protection has grown to a stage where it has become increasingly difficult for non-specialists to keep abreast of the situation.

The aim of the book is to set out the basic and old-established requirements and at the same time draw attention to recent developments such as long-life coatings, new International Standards on surface preparation, new methods and standards of quality control and the increased awareness of health and safety factors.

The book is not intended to be a comprehensive textbook on coating technology but rather a guide to the principles involved and methods of achieving sound steel protection. Unless otherwise stated, the views expressed are those of the authors, based on many years' practical experience.

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We also take this opportunity of acknowledging the work of our colleagues in this field. They are too numerous to mention, but many of the views expressed in this book have arisen from discussions with them and the study of their contributions to journals and conferences over the years.

DEREK A. BAYLISS
KENNETH A. CHANDLER

Contents

CHAPTER 1

Introduction

Many Resident Engineers for major building projects nowadays echo the sentiment that 'Painting amounts to 10% of the job but provides 90% of the problems.' Yet at the same time there are, unquestionably, large areas of coated steelwork withstanding the most adverse conditions for surprisingly long periods. A typical example is the coating of offshore platforms in the North Sea. Even in less exotic circumstances, for example bridge structures inland, engineers have successfully extended repainting cycles by as much as three times compared with practices of only twenty years ago. The majority of coatings used nowadays have considerably improved properties over the materials used then. However, this is not the sole reason for the success. The following factors have become even more important than previously:

(i) Coating specifications should say what they mean and mean what they say. See Chapter 8.
(ii) Coating manufacturers' recommendations regarding application and suitability of their products for the relevant conditions should be followed as closely as possible. See Chapter 14.
(iii) Materials supplied should be of a consistent standard of quality. See Chapter 16.
(iv) Surface preparation should be no more or no less than is required to achieve the specified durability. See Chapter 3.
(v) Because of the variable performance that can be obtained owing to sometimes even minor differences in the preparation and application process, the whole operation, ideally, should be monitored by a competent and qualified coating inspector. See Chapter 9.

It can be shown, even to the satisfaction of the accountants, that in the majority of cases there are substantial economic benefits to be gained in the long term by adopting sound coating practice. In the short term however, the costs are likely to be higher and this must be appreciated by all concerned (see Section 14.5.2).

As things stand today, there is little wonder that even relatively young engineers seem to yearn for the days when painting steel structures meant little more than a perfunctory wire brushing followed by red lead in oil primer, followed by two coats of gloss paint. Indeed, only about twenty years ago this was the standard paint system for many major structures, such as the structural steelwork of new power stations in the UK. The advantages of such a system were cheapness and foolproofness. Durability was generally only about 4 years for exterior exposure but the process could be repeated without much expense or trouble. However, there is little question that in modern times the slow drying, toxicity (see Chapter 17) and repeated cost of maintenance (see Section 14.5) would be unacceptable. In contrast, today there are several office buildings in London where the exposed steelwork has been painted with a zinc silicate primer and two-pack urethane top-coats. That is a coating system with probably the greatest durability and least tolerance during application (see Chapter 4). Also there are structures with very limited and expensive access that are being painted with three coats of moisture-cured urethane during the course of one day, even under damp and other adverse conditions (see Section 4.9.3.5).

In fact, this revolution in the paint industry could really be said to have started back in 1938. Dr Pierre Castan of Switzerland, a chemist working for a firm making dentures, invented epoxy resins. A Swiss patent for the invention was filed in 1940 and for a curing agent in 1943. However, the firm was unable to exploit the discovery sufficiently in the dental field and sold the rights to what is now CIBA-Geigy. They started to market epoxy resins, under the tradename Araldite, in 1946. Subsequently Shell (USA) also purchased the patent and marketed under the tradenames Epon and Epikote. However, it was at least a decade later that such materials began to be accepted for such specialist operations as tank lining.

Of course, other synthetic resins had also become available, including chlorinated rubbers, vinyls, etc. (see Chapter 4), but it is the epoxies, and later the urethanes, in their infinite variety that have led to some of the complications of today. For the first time the paint chemist was able to tailor-make resins to meet almost any requirement. The result was that in the competitive world of the paint industry each paint firm felt the need to produce something different from its competitors or alternatively to match every product. Currently most paint manufacturers in the UK have at least 90 product items in their published collection of data sheets and this only represents a fraction of those that they can supply for special purposes. In addition, the data sheets themselves are unlikely to give all the information, good or bad, about the product that is necessary to make the correct choice. In fact, without very close and expert study of the information supplied it is often very difficult to see why one should choose one item rather than another. Some manufacturers do not even reveal the nature of the binder (see Section 4.1) on which their product is made. Sometimes this is because it is a modification or mixture of binders. It is little wonder that many engineers, and others, find the subject confusing.

The development of quick-drying, high-build coatings has also brought another complication, namely the need for high standards of surface preparation. Even for the old-established oleo-resinous systems, it has been known for many years that application on to cleaned surfaces, such as blast-cleaned (see Section 3.2.3) or pickled (see Section 3.2.6) gives consistently greater durability than with hand cleaning.

The production of the first edition of the Swedish Standard photographs of rust and preparation grades in 1946 was a far-sighted work of exceptional quality for its day. This standard was soon used, or at least paid lip-service, by most of the industrial nations.

In 1978 there was the first meeting of the International Standards Organisation, Sub-committee ISO/TC 35/SC12. The objective of this committee was to produce standards for the preparation of steel substrates before the application of paints and related products. It expected to produce a standard similar to, if not identical to, the Swedish Standard, However, it soon became obvious that it was difficult to define accurately the contamination represented by the different photographs in the Swedish Standard and, in particular, to relate these to the numerical ratings favoured by the American Standards. This has not yet been resolved entirely satisfactorily (see Section 9.5.1.2), but the ISO Standard and the British Standard were eventually published in 1989, only as first of many parts, however. Eventually there are likely to be standards for surface contamination on; determination of soluble iron corrosion products, dust, oil and grease, chlorides, risk of condensation, conductivity and pH. There will also be standards for the composition and cleanliness of abrasives (see Section 9.5.1.7).

All this may well make the specifier's task more effective, but certainly not easier. One suspects that there will be a real danger of demanding the lowest limits of contamination in all circumstances and regardless of the actual requirements. Clearly there is a need for specifiers, who may be practising engineers, architects, designers and others, for whom corrosion