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book reviews

FRETTING CORROSION, by R. B. Waterhouse, Pergamon Press, $19.50, 253 pp.

REVIEWED BY RICHARD C. ROSENBERG

This, the first book devoted exclusively to the subject of fretting corrosion, is a welcome addition to the literature. In the past, discussion of this subject has been limited to either a single chapter in corrosion books or to the subject of a symposium.

Fretting is encountered in machine elements which experience either relative motion or vibration. Bearings, couplings, seals, and wire ropes are among the most commonly affected parts. This book treats the subject for engineers who are trying to prevent fretting, and for scientists who are trying to understand the mechanism of fretting.

The author, a frequent contributor to the literature in this field, is well qualified to write such a book. Currently, a Reader in Metallurgy at the University of Nottingham, he has spent more than 20 years studying fretting corrosion. His background in both tribology and metallurgy provide him with the unique qualifications needed to write this book.

The Introduction tends to be confusing because after stating the definitions for fretting and fretting corrosion as described by the Organization for Economic Cooperation and Development, the author disagrees with these definitions and then provides his own. Following the Introduction, the author covers the theoretical aspects of contact and the experimental methods of investigating surfaces and surface contacts. While the coverage of the mechanical aspects of surface contact is adequate, the influence of surface films (such as oxides) could have received more attention. Practical examples of fretting are dealt with in the next chapter. These examples range from the fretting fatigue observed in rivetted joints to the fretting of nuclear reactor fuel elements.

Chapter 5 deals with the experimental methods used to study fretting corrosion. In this chapter, the author shows 15 different experimental devices which have been used to produce fretting corrosion. More space than necessary is probably devoted to these apparatuses, considering their limited interest to the potential audience. The characteristics of fretting damage and the effects of variables on fretting are discussed in the next two chapters. The influence of fretting on the initiation of fatigue cracks is covered in the following chapter. Next the author covers the influence of fretting on the adhesive behavior of metals, followed by an interesting chapter on the electrochemical and corrosion aspects of fretting. Methods of preventing fretting damage are dealt with next. Some of the material contained in the last chapter, on the mechanics of fretting, could have been covered earlier in the book.

As the first book in this field, the author has done a remarkable job of providing the reader with current information about fretting corrosion. The 265 references will be valuable to anyone wishing to explore this subject further. This book can be recommended for engineers who are faced with problems in fretting and fretting corrosion. For these people, it provides a large number of solutions to fretting problems and explanations as to why these solutions work. This is not an easy task since the prevention of fretting often involves two apparently conflicting solutions. In some cases, relative motion between the surfaces is increased to prevent damage while in other cases motion must be eliminated. Researchers in the field will find the book of interest because the author has compared the works of different investigators and drawn the results of these investigations into concise conclusions.

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Fretting corrosion is primarily a surface damage phenomenon occurring as a result of small cyclic movements between two materials caused by cyclic loading. Fretting damage can occur in vacuum, although it then would be better to speak of fretting, rather than fretting corrosion. In normal air, corrosion plays an active role in causing fretting corrosion damage. The other contribution comes from rubbing between two material surfaces. Fretting corrosion is a cyclic process in which the passive oxide layer is continuously removed and reformed, gradually wearing away at the surface of the implant. From: Bone Repair Biomaterials, 2009. Related terms: Galvanic Corrosion. Fretting. Corrosion. Stress Corrosion Cracking. Fretting is usually accompanied by corrosion (in a corrosive environment). In fretting there is no macroscopic sliding. The surfaces are nominally in static contact in the central region of a contact (for a ball on flat case), where the normal pressure is high.Â Fretting is commonly combined with corrosion, a wear mode known as fretting corrosion. Due to rupture of the material and formation of debris, fresh surface is exposed to air which subsequently is getting oxidized (depending on the inertness of the material). Fretting corrosion refers to corrosion damage at the asperities of contact surfaces. This damage is induced under load and in the presence of repeated relative surface motion, as induced for example by vibration. Pits or grooves and oxide debris characterize this damage, typically found in machinery, bolted assemblies and ball or roller bearings. Contact surfaces exposed to vibration during transportation are exposed to the risk of fretting corrosion.