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### **A review of: “ADHESION AND ADHESIVES: SCIENCE AND TECHNOLOGY, by A. J. Kinloch, Chapman and Hall, London and New York, 1987, 441 pp., US \$85.”**

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## Book Review

ADHESION AND ADHESIVES: SCIENCE AND TECHNOLOGY, by A. J. Kinloch, Chapman and Hall, London and New York, 1987, 441 pp., US \$85.

The author states that "... the present book attempts to review the multidisciplinary subject of adhesion and adhesives, considering both the science and technology involved in the formation and mechanical performance of adhesive joints." In fact, he has succeeded admirably in striking a balance between matters of theoretical and practical interest. He seems also to have aimed at a level of presentation which would be useful to a wide variety of readers, of differing backgrounds and previous knowledge. In this, he has generally been successful, except in a few instances, to be mentioned below.

A short introductory chapter begins with a useful word of caution on the importance of considering the adhesive joint as an "adhesive system," and then gives a brief outline of the plan of the volume. The chapter concludes with a considerable number of interesting examples of current adhesive technology, doubtless intended to motivate readers who are not already familiar with the subject. This approach is typical of the book as a whole: the discussion of each topic begins with an outline of significant points, which should help to orient a novice, then passes on fairly rapidly to the complexities of modern theory and practice. Throughout, the emphasis is on relatively recent work, although the historical background is not slighted.

The book begins in earnest with a chapter which describes "the various aspects which influence the attainment of intimate molecular contact between the liquid adhesive and the substrate materials which are to be bonded." The discussion deals in some detail with the theoretical approaches to the subject and also with relevant experimental results, pointing out the many contradictions and questions which remain to be resolved, and giving along the way a number of useful hints for coping with practical problems.

The next chapter, on "mechanisms of adhesion," takes up the major explanations which have been proposed for the phenomenon of adhesion, and critically discusses the evidence for each. There is a healthy emphasis on the importance of the distinction between "work of adhesion" and "joint strength." A weakness in the organization of this chapter is that the important topic of the newer methods of surface analysis is scattered throughout the text, rather than being fully described in one place for ready reference.

A chapter on "surface pretreatments" contains a wealth of practical detail which reflects the broad range of the author's experience. Considerable attention

is paid to the attempts which have been made to explain the success, or lack of success, of commonly used pretreatment methods, as well as to the balance between effectiveness and cost which must be considered in commercial applications. The material in this chapter should be of great value to anyone faced with the problems which arise when attempting to produce a functional adhesive bond.

The following chapter, on "hardening of adhesives," contains brief descriptions of the chemistry, applicability and behavior of the commonly used adhesives. The reader is referred to other sources for details. The level of the discussion is fairly elementary, and best suited to a beginner in the field; this reflects the author's overall emphasis on the physics and engineering aspects of the subject, rather than the chemical side.

The chapter on "mechanical behavior of adhesive joints" begins with a clear introduction to the subject of test methods, including many practical details. It then moves on to a fairly detailed discussion of stress distributions in adhesively bonded structures. This part of the book may prove to be rather hard for those who are new to the subject. The exposition sometimes jumps back and forth between fairly elementary and rather advanced viewpoints, and shows an unfortunate tendency merely to quote equations rather than explain their physical implications. The chapter concludes with an informative survey of the methods available for nondestructive testing of adhesively bonded structures.

The next chapter, on "fracture mechanics of adhesive joints," suffers from some of the same problems. The topic is of such great importance that it deserves a clearer introduction for the beginner, before the more advanced details are presented. The reader who has difficulty would be well advised to persist, however, as the author's treatment includes even the more recent developments in the subject. Since the discussion often refers back to equations and data presented many pages earlier, it would have been helpful if page numbers had been given more often in conjunction with the equation and figure numbers which are quoted.

The final chapter, on "the service life of adhesive joints," deals with the effects of static and dynamic fatigue, environmental attack and life prediction in a compact yet thorough manner. The discussion of each topic begins with a useful statement of basic principles, followed by a skillful combination of the theoretical background and relevant practical details.

To summarize, the author is to be congratulated on having achieved a comprehensive and perceptive treatment of the current status of the subject, within a volume of moderate size. In spite of the reservations noted above (and the somewhat idiosyncratic punctuation!) this book can be recommended to anyone who has more than a superficial interest in the field, including specialists who wish to understand the significance of recent work in areas outside their own.

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