A Textbook of Engineering Chemistry

For the Students of B.E., B.Tech., B.Sc. [Engg.] A.M.I.E., M.Sc. (Environmental Chemistry), M.Tech. (Environmental Engineering) and other Competitive Courses.

S.S. DARA
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S. CHAND

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PREFACE TO THE TWELFTH EDITION

Any good text book, particularly that in the fast changing fields such as engineering and technology, is not only expected to cater to the current curricular requirements of various institutions but also should provide a glimplse towards the latest developments in the concerned subject and the relevant disciplines. It should guide the periodic review and updating of the curriculum. It is precisely with this spirit that new topics have been constantly added in every Edition of this book. This approach has been appreciated and encouraged by the students and the faculty of the various engineering institutions in the country as indicated by the phenomenal response received for this book over the past two decades. This new Twelfth Edition of the book is another effort in that direction.

In this edition, several chapters have been updated and revised keeping in view of the recent developments. In the chapter on "Water treatment" desalination of water and some additional numericals on water treatment have been included. In the chapter on "Fuel and Combustion" the new topics such as catalytic converter, LPG, CNG, power alcohol, biodiesel and some numbericals on combustion calculation of current interest have been included. In the chapter "Cement" topics on properties such as soundness, fineness of cement and use of fly ash as cementing material have been included. In the chapter on "Lubricants" viscosity index and re-refining of lubricating oil is included. In the chapter on "Corrosion" the problem on corrosion tendency of metal is included.

In the chapter on polymer serveral advance topics such as conducting polymers, biopolymers, low dielectric constant polymers, liquid crystal polymers have been added and lot of text in this chapter has been re-written for greater clarity and simplicity. New diagrams have been incorporated and a number of the old one have been improved upon.

The text in the chapter composite have been added. One detailed section on the magnetic material have been added in the chapter, structure of solids. The title of the chapter "Ceramics" have been change by "Glass and Ceramics" and the text on glass is included. Further, the printing mistakes have been corrected and several other chapters have been updated wherever possible.

I sincerely thank the student and teaching community of engineering and technology faculty all over the country. It is solely their encouragement, suggestions, feedback and constructive criticism that is responsible in carving out this book in the present form.

This twelfth revised, enlarged and enriched edition of the book is sincerely offered at the service of students and teaching fraternity associated with engineerng chemistry from the various engineering and technological institutions all over the country. It is hoped that this new edition of the book will be received with vibrant enthusiasm.

AUTHORS

PREFACE TO THE FIRST EDITION

This book is written exclusively for students of various branches of engineering, keeping in view their professional requirements, after entering into their practical life. Many new products of the chemical industries are finding increasing application in all the fields of engineering. The scope of their application is mostly dictated by their chemical behaviour under a given set of conditions. For instance, an ideal selection of an appropriate metal, metal, alloy, or combination of metals, the design of an equipment to minimize corrosion, the selection of a proper lubricating oil to minimize friction and wear, the selection of suitable additives for a special cement or the selection of the right type of a ceramic, plastic or rubber for satisfactory performance for a given purpose under a given set of conditions, can be made only on the basis of the chemical properties of materials, even more than on their physical properties because slight changes in chemical composition may alter the physical properties considerably. Inadequate knowledge of the chemical principles involved may lead to serious errors in the selection and application of the materials used in any field of engineering. It is for this reason that the engineering faculties of many foreign universities are insisting on a second course in Chemistry for their students. This book lends further support for their conviction that "the engineering graduate who knows the differences in chemical properties of alternative materials and who understands the general chemical principles on which their behaviour depends will prove to be a better and more successful engineer than one who does not."

This book embodies 12 chapters which are of basic importance in the curriculum of engineering students and provide a core course of engineering chemistry for all branches of engineering. Each chapter consists of a methodical introduction, historical background, discussion of basic physico-chemical principles involved and practical applications and significance. Chapters on Water and Fuels also contain systematic methods of solving problems on Water Treatment and Combustion Calculations followed by several worked out examples. Further, at the end, enquiring questions on all the chapters are given which also include typical objective questions and answers. A list of reference books has also been included at the end, under bibliography.

This book is written solely with a conviction to severe the academic and professional requirements of the students of all branches of engineering.

Any suggestions and constructive criticism towards this objective are welcome.

Jan. 1986

AUTHOR

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1

Water Treatment

"Water is one of the most abundant commodities in nature, but is also the most misused one."

1.1. INTRODUCTION

One of the basic necessities of life is water. Living things exist on the earth because this is the only planet that has the presence of water. Water is necessary for the survival of all living things be it plant or animal life.

Water is one of the most abundant commodities in nature but is also the most misused one. Although earth is a blue planet and 80% of its surface is covered by water, the hard fact of life is that about 97% of it is locked in the oceans, and sea which is too saline to drink and for direct use for agricultural or industrial purposes. 2.4 % is trapped in polar ice caps and giant glaciers, from which icebergs break off and slowly melt at sea. >1% water is used by man for various development, industrial, agricultural, steam generation domestic.

1·2. SOURCES OF WATER

Water is required for agricultural, municipal and industrial purposes. For industrial purposes, natural waters may be broadly divided into the following categories:

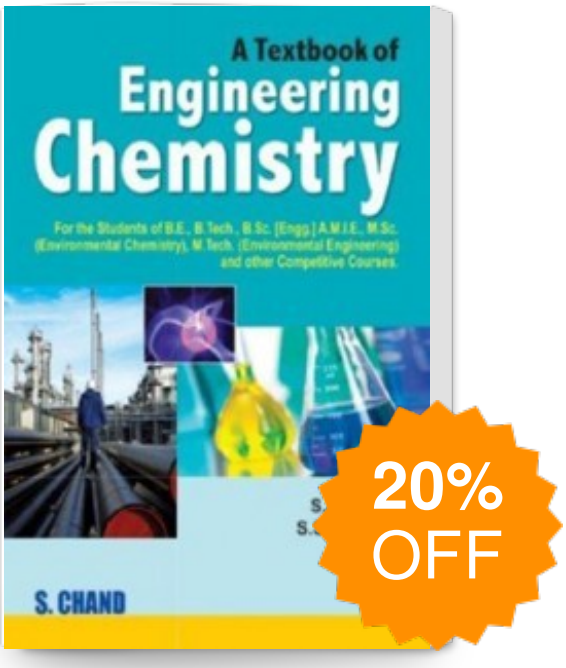
(1) Surface waters:
   (*a*) Flowing waters *e.g.*, streams and rivers (Moorland surface drainage)
   (*b*) Still waters *e.g.*, ponds, lakes and reservoirs (Lowland surface drainage)
(2) Underground water: Water from shallow and deep springs and wells
(3) Rain water
(4) Estuarine and sea water

From the point of view of industrial applications, it is not usually feasible to use rain water and sea water. Rain water is irregular in supply and generally expensive to collect. Estuarine and sea waters are too saline for most industrial uses except cooling. The three major sources of water for industrial use are

(*a*) Moorland surface drainage.
(*b*) Lowland surface drainage.
(*c*) Deep well water.

The important properties of these three types of waters are given in Table – 1.

A Textbook Of Engineering Chemistry



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