

A COMPREHENSIVE GUIDE TO THE HAZARDOUS PROPERTIES OF CHEMICAL SUBSTANCES

Third Edition

PRADYOT PATNAIK

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THIRD EDITION

Pradyot Patnaik, Ph.D.



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To my wife Sanjukta

PREFACE

In this third edition of the book all the chapters of the last edition were fully reviewed. Some new chapters have been added into this edition. In the Part A of this book two new chapters have been incorporated. These topics are “Chemical Warfare Agents” and “Biological Warfare Agents and Bioterrorism”. In these two chapters various chemical and biological agents including incendiaries, obscurants, sulfur and nitrogen mustards, lacrimators, bacteria, viruses and toxins that are known or potential weapons of warfare or terrorism are highlighted. These chapters are included in this book because of the public interest on these topics at the moment and as per suggestions I received from many readers.

In the Appendices section, the lists of carcinogenic agents, classified by the International Agency on Research on Cancer is updated to 2006. Also the US National Toxicological Program’s list of cancer-causing agents as per their 11th edition (2004) is presented in a separate Appendix. Under the appendix titled Federal Regulations, a subsection has been added listing the “priority pollutants” as classified by the US Environmental Protection Agency for the benefits of those readers in environmental toxicology.

In the Part B of this text several new entries have been inducted. Many compounds are entered in the tables under miscellaneous substances in several chapters. Molybdenum has been added as a subchapter into Metals, Toxic. A number of chapters of the last edition have been fully revised in this edition. Notable among them are, Nerve Gases; Dioxin and Related Compounds; Metals, Toxic; Pesticides, Organochlorine-, Organophosphorus-, Carbamates-, and Chlorophenoxy Acids-; Amines, Aromatic; Isocyanates, Organic; Halogenated Hydrocarbons; Hydrocarbons, Aromatics; Asbestos; Nitriles; and Nitrosoamines and a number of individual compounds such as Napalm. Practically all the entries of the previous edition have been retained in this edition. All revisions have been updated wherever possible to the year 2006.

I will greatly appreciate it and gracefully acknowledge for any thoughtful suggestions and comments from the readers for any further improvement of this book.

Pradyot Patnaik

PREFACE TO THE FIRST EDITION

The subject of hazardous properties of chemical compounds constitutes a very wide area which includes topics of wide diversity ranging from toxicology and explosivity of a compound to its disposal or exposure limits in air. In fact, each of these topics can form a subject for a book on its own merits. There are several well-documented books on these topics. However, most of these works show important limitations. The objectives of this book, therefore, are (1) to present information on many aspects of hazardous properties of chemical substances, covering the research literature up to 1991, and (2) to correlate the hazardous properties of compounds to the functional groups, reactive sites, and other structural features in the molecules; and thus to predict or assess the hazards of a compound from its structure when there is lack of experimental data.

The hazardous properties are classified under two broad headings: health hazard and fire and explosion hazard. The former includes toxicity, corrosivity, carcinogenicity, mutagenicity, reproductive toxicity, and exposure limits. Flammability, violent and explosive reactions, incompatibility, and fire-extinguishing agents are discussed at length under fire and explosion hazard. In addition, information is provided on physical properties, uses, storage, handling, disposal/destruction, and chemical analyses. These are presented in 46 Chapters covering organics, metals and inorganics, industrial solvents, common gases, particulates, explosives, and radioactive substances. All

the Chapters except those on azo dyes, industrial solvents, common toxic and flammable gases, particulates, and RCRA and priority pollutant metals are arranged in accordance with their structures and reactive functional groups. In other words, substances of same families are grouped together. A general discussion on the chemistry, toxicity, flammability, and chemical analysis is presented for each class of substances. Individual compounds of moderate to severe hazard and/or commercial importance are discussed in detail. Relationship of structures with hazardous properties are highlighted.

Individual compounds in each class of substance are discussed in most Chapters under the following features: formula; molecular weight; CAS registry number; EPA (RCRA) and DOT status; structure; synonyms; uses and exposure risk; physical properties, including color, odor, melting and boiling points, density (mg/L), solubility, and pH (if acidic or alkaline); health hazard, which includes toxic, corrosive, carcinogenic, and teratogenic properties; exposure limits set by ACGIH, OSHA, MSHA, and NIOSH; fire and explosion hazard, which includes flammability data, fire-extinguishing agents, and explosive reactions; storage and shipping; disposal/destruction, including laboratory methods for destruction and biodegradation; and chemical analyses, which include general instrumental techniques as well as specific analysis of compounds in water, soils, sediments, solid wastes, and air, and biological monitoring. Deviations from the foregoing

format are noted in many Chapters for less hazardous substances or for lack of information. Also if the methods or procedures are similar, a detailed discussion is presented only for a few of the prototype compounds. The topics that are reviewed in greater detail are toxicological properties, violent reactions and explosive products, biodegradation, and chemical analysis of more hazardous substances.

This book is divided into two major parts. Part B presents a comprehensive discussion

of individual substances and classes of substances, Part A highlights the four primary hazardous properties: toxicity, carcinogenicity, flammability, and explosive characteristics of chemical substances. The salient features of various federal regulations for the protection of human health and the environment are discussed in brief in Part A.

It is hoped that this book serves its purpose. Any comments, criticism, or suggestions from readers for further improvement of the book will be greatly appreciated.

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