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HANDBOOK

of

ORGANIC INDUSTRIAL SOLVENTS

Second Edition

NATIONAL ASSOCIATION OF MUTUAL CASUALTY COMPANIES

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FOREWORD

This publication was developed by the Industrial Hygiene Subcommittee of the National Association of Mutual Casualty Companies. Its need was suggested by the continued rapid development of new solvents, their increasing prominence in industrial operations, and the attendant health hazards. Since the safety engineer is usually one of the first to encounter the exposure, this Handbook has been prepared primarily for his use.

To assist the safety engineer in his analysis of these problems, the fundamentals of solvent exposure hazards and their control were considered. A list of the common solvents was compiled, along with pertinent data needed in evaluating hazards. In addition, a list of the effects of these solvents on humans is included. From these data the safety engineer can make his own general evaluations of potential solvent hazards, and from such evaluations he selects those exposures which should then be referred for further study.

This Handbook is a compilation of the already existing data, except for the Evaporation Rates which were determined as a part of a research project sponsored by the Association. The footnotes in the Table of Solvent Properties pertaining to the effects of solvents on humans are interpretations of published information.

The first edition of the Handbook was published in 1958. This second edition is a revision of the text, and it also contains additional solvent data.

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NATIONAL ASSOCIATION OF MUTUAL CASUALTY COMPANIES

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The National Association of Mutual Casualty Companies is an organization of twenty-eight of the nation's principal mutual casualty insurance companies.

The oldest was founded in 1887, and was the first company organized in the United States to write liability insurance.

These companies hold membership in the association because they are established and acknowledged leaders in the casualty insurance field. They write about half of all premiums written by mutual casualty insurance companies in this country, and are an especially important factor in the field of workmen's compensation insurance.

In their many years of service to industry and to individuals, these companies have seen the mutual insurance principle—THAT PREVENTION OF LOSS IS BASIC IN THE EFFECTIVE ORGANIZATION OF INSURANCE PROTECTION—cease to be regarded as a novelty and come to prevail throughout America.

Ever since its organization in 1917, a principal concern of the National Association of Mutual Casualty Companies has been the improvement of loss prevention by every available means. This has meant close and helpful cooperation with other organizations concerned with such problems, and it has meant continuing emphasis upon research and application of sound safety engineering principles to the activities of the policyholders of the member mutual casualty insurance companies. The effects of this promotion of safety long since have spread beyond the circle of mutual insurance policyholders to benefit the public generally, and every effort is made to insure that they will continue to do so.

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THE SCIENTIFIC BASIS OF TOXICITY ASSESSMENT

Proceedings of the Symposium on The Scientific Basis of Toxicity
Assessment held in Gatlinburg, Tennessee, U.S.A., 15-19 April, 1979.

Editor

HANSPETER R. WITSCHI



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PREFACE

For more than 30 years the Biology Division of the Oak Ridge National Laboratory has sponsored an annual spring conference. Each of these symposia has covered an area in which significant and exciting new research was being done and which promised that even more knowledge of fundamental biological processes would be developed in the near future.

In April 1979 the theme of the conference was "The Scientific Basis of Toxicity Assessment." During the last few years, the science of toxicology has received much attention. There is an ever growing awareness that toxic hazards in our daily environment may be a threat to our well-being. It is the goal of toxicology, as a predictive science, to understand such hazards. Only then will we be able to deal successfully with both the real and the imaginary hazards we face today and in all likelihood will continue to face in the future if we hope to maintain and to improve the quality of life. Research in toxicology will never guarantee us absolute safety. However, sound and responsible toxicology will help to make intelligent decisions and will assist us in weighing risks against benefits in the assessment of our increasingly complex chemical environment.

In order for toxicology to be a truly predictive science, we need to explore and to understand how chemicals affect the structural and functional integrity of living organisms. Knowledge has to be acquired at each level of biological organization and the powerful tools of modern research must be fully exploited.

The scope of the present meeting was deliberately a broad one. The problems and issues in toxicology were defined first. A discussion followed which explored new avenues on how to detect and how to predict untoward interactions of chemicals with living systems. The pathways of chemicals through the environment, within animals and single cells, and their interaction with critical target molecules were described with

selected examples, and the role of metabolism of foreign compounds in producing toxicity was explored. Of equal importance was to learn how the organism reacts toward a chemical insult. Finally, three most basic questions were discussed: how do we best use the information we generate in experiments with animals to predict hazard for man, what can toxicology learn from the closely related discipline of radiation biology, and where has the basic approach to toxicological problems met with success. The papers in this volume hopefully will give us some indication how close we have come to our goals and will help to identify directions of future research.

At this point it is a pleasure to thank all my colleagues who helped to plan this meeting: Dr. Robert A. Neal, Vanderbilt University, Nashville; Dr. J. E. Gibson, Chemical Industry Institute of Toxicology, Research Triangle Park; Drs. S. I. Auerbach and C. W. Gehrs, Environmental Sciences Division, ORNL, and, from the Biology Division, Drs. R. J. M. Fry, R. F. Kimball, S. Mitra, J. K. Selkirk and T. J. Slaga. The success of even the best planned meeting depends upon enthusiastic speakers and a receptive audience; we were fortunate to have both. Particular thanks go to the then Director of the Biology Division, Dr. J. B. Storer, and to the Associate Director for Biomedical Sciences of ORNL, Dr. C. E. Richmond, for their continuing support.

The meeting was sponsored by the Biology Division of the Oak Ridge National Laboratory (operated by the Union Carbide Corporation for the Department of Energy). Travel for speakers and chairpersons was supported by a grant from the National Institute of Environmental Health Sciences.

Finally, I would like to acknowledge the most competent and unfailingly enthusiastic help of Mrs. Mary Jane Loop, without whose experience and cheerfulness the meeting never would have gone as smoothly as it did.

Hanspeter Witschi

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NEW OUTLOOKS AND APPROACHES TO TESTING: INTRODUCTION

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The theme of this section of the symposium on "The Scientific Basis of Toxicity Assessment" is entitled "New Outlooks and Approaches to Testing." This title is one which always has been and always will be in tune with the times. Researchers are always searching for new, better and quicker ways to solve their problems. Through the years the techniques and approaches to toxicology testing and safety evaluations have continuously improved and will continue to improve. Many of the test procedures used in the past are viewed as crude and inadequate by today's standards and yet they provided much basic information useful today. It should be emphasized that merely because a test is old does not necessarily mean that it was the source of incorrect data. More likely the problem was not with the data but with the inadequacy of its interpretation, past and present. Many of the newer test procedures and concepts are merely refinements and extensions of proven older procedures made possible by technological advances such as have occurred in analytical chemistry. There is no doubt that the techniques viewed as sophisticated today will be commonplace in two or three years and some will be replaced with better ones in the next few years. The rate at which new and better approaches to testing will be devised and validated will be commensurate with the need and our ability to unravel the mysteries of biological systems.

There is no question that there is a serious need for technology to rapidly test chemicals and mixtures of chemicals for their potential to cause serious adverse effects such as cancer, genetic aberrations and behavioral or neurological changes in human beings. A multitude of investigators are responding to these needs.

Researchers have been studying the response of many ingenious biological systems to various types of chemicals in an effort to find a test or a battery of tests that will yield data in a short time from which reliable predictions can be made as to long term effects of a test material. Others are attempting to refine old techniques, develop new tests and describe the limitations of various animal models for detecting and measuring the capacity of materials to alter behavior and to determine by what mechanism the alterations occur.

Considerable effort is now being expended to elucidate the biochemical mechanisms through which chemical carcinogenesis develops. There is good reason to believe that differences between species and strains in susceptibility to particular chemicals may be attributable to differences in inherent biochemical capabilities. Most certainly a better understanding of such basic mechanisms whether in monocellular organisms, tissue cultures or whole animals, will permit a far better interpretation of data from the various models and its extrapolation to the human being.

The following four papers by recognized authorities in their fields present a comprehensive review and evaluation of the state-of-the-art in several categories of testing. This insight should be very valuable not only to researchers in the particular fields but also to those in related fields of research, to administrators, to product planners and to regulators involved with safety evaluations.