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Handbook for Estimating Physicochemical Properties of Organic Compounds

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This *Handbook* was prepared by Professor Martin Reinhard (Department of Civil and Environmental Engineering, Stanford University, Stanford, California, USA) and Dr Axel Drefahl (Institute of Physical Chemistry, Technical University/Bergakademie Freiberg, Freiberg, Sachsen, Germany). It consists of a preface, 14 chapters, seven appendices and an index. Each chapter is supplied with a list of references. The aim of the *Handbook* is to introduce the reader to the concept of property estimation and to summarize property estimation methods used for a variety of physicochemical properties. The importance of the property estimation methods is at least threefold: (i) they provide rapid estimation of physicochemical properties of molecules (quality of the estimation of physicochemical properties in some cases is nearly as good as measured values), which is often the necessary condition for many tasks that face chemists and chemical engineers when time is a factor, (ii) they may help in devising preparative strategies for yet unknown compounds, and (iii) they are the main tool of the drug designer.

The *Handbook* can be used on its own or together with the *Toolkit for Physicochemical Properties of Organic Compounds* (developed by the authors in 1998), an easy-to-use Windows®-based program for rapid estimation routines and flexible search capabilities.

The first chapter is entitled »*Overview of Property Estimation Methods*« (25 pages, 50 references). This chapter presents classes of estimation methods, predictor variables and physicochemical properties whose estimation will be discussed in subsequent chapters. It is emphasized that the important chemical principle involved in property estimation is structural similarity. The following classes of property estimation methods are briefly described: quantitative property-property relationships (QPPRs), quantitative structure-property relationships (QSPRs), group contribution models (GCMs), similarity based models (between isomeric compounds, between homologous compounds and between similar compounds), group interchange models (GIMs), nearest-neighbours models and mixed models. The first two methods are probably the most common methods for estimating physicochemical properties of molecules. In our classification (*e.g.,* N. Trinajstić, M. Randić and D.J. Klein, On Quantitative Structure-Activity Relationship in Drug Research, *Acta Pharm. Jugosl.* **36** (1986) 267–279), the first method is

termed as structure-cryptic or empirical method and the second as structure-explicit or nonempirical method. The considered physicochemical properties include density, molar volume, refractive index, molar refraction, surface tension, parachor, viscosity, vapor pressure, enthalpy of vaporization, boiling and melting points, aqueous solubility and partition coefficients.

The second chapter is entitled »*Computable Molecular Descriptors*« (13 pages, 32 references). This chapter contains recipes for computing various topological and information-theoretical indices. The authors did not mention topographic (3 D) indices and available computer programs for computing indices (e.g., CODESSA), except program GRAPH III by Sabljić and Horvatić. A good reference for 3 D indices is the following book: A. T. Balaban (editor), *From Topology to Three-Dimensional Geometry*, Plenum Press, New York, 1997. This book was also reviewed here, *e.g.,* N. Trinajstić, *Croat. Chem. Acta* **71** (1998) A17-A19. Nothing is said about (ordered) orthogonal indices either (see, for example, B. Lučić and N. Trinajstić, New Developments in QSPR/QSAR Modeling Based on Topological Indices, *SAR QSAR Environ. Res.* **7** (1997) 45–62, and references therein). Ordered orthogonal indices have shown all kinds of advantages over the standard nonorthogonal indices.

The remaining twelve chapters (from Chapter 3 to Chapter 14) deal with estimation of a given property. These are: *Density and Molar Volume* (15 pages, 48 references), *Refractive Index and Molar Refraction* (7 pages, 25 references), *Surface Tension and Parachor* (6 pages, 14 references), *Dynamic and Kinematic Viscosity* (9 pages, 26 references), *Vapor Pressure* (9 pages, 27 references), *Enthalpy of Vaporization* (9 pages, 26 references), *Boiling Point* (14 pages, 45 references), *Melting Point* (10 pages, 13 references), *Aqueous Solubility* (22 pages, 74 references), *Air-Water Partition Coefficient* (8 pages, 19 references), *1-Octanol-Water Partition Coefficient* (23 pages, 68 references) and *Soil-Water Partition Coefficient* (7 pages, 25 references). A valuable feature of each chapter (except for Chapter 12 on air-water partition coefficient) is a table containing a summary of uses for a given physicochemical property. Data given in these chapters are very useful and many a practitioner of the structure-property modeling will make use of them. This reviewer wonders why work by Katritzky and his group at the University of Florida (Gainesville) is not mentioned since they did a lot of important work on estimating a variety of physicochemical properties.

At the end of the *Handbook*, there are seven appendices containing description of the Simplified Molecular Input Line Entry System (SMILES) notation (Appendix A), different temperature functions: density-temperature functions (Appendix B), viscosity-temperature functions (Appendix C) and air-water partition coefficient-temperature functions (Appendix D), then contribution values to the logarithm of aqueous solubility of group parameters in the models of Klopman, Wang and Balthasar (*J. Chem. Inf. Comput.*

Sci. **32** (1992) 474–482) (Appendix E), system of atomic contributions for the calculation of the n-octanol/water partition coefficients of Broto, Moreau and Vandycke (*Eur. J. Med. Chem. – Chim. Ther.* **19** (1984) 71–78) (Appendix F), while various notations used in the text are collected in Appendix G.

To summarize, this *Handbook* represents a very informative source for researchers doing or intending to do modeling of physicochemical properties of organic compounds.

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