be of value to the pharmaceutical researcher occasionally using such surface and interface analysis techniques. It will not teach you how to use the methods, but will help you to understand the challenges of surface analysis. What is wrong with the first three chapters? The reflections of the editors about the 'good old days' of surface science in the universities I find boring and outdated. Their attempt to describe the problems solving sequence are, I suppose, vaguely interesting. By the time I have read through the text, however, I could have thought out the way to solution of my problem intuitively.

This book deserves thus a half recommendation. If you need to consult it, perhaps it would be better to borrow it from the physics library. $200 would be better spent for your pharmaceutics library on other books.

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Pharmaceutical Water (System Design, Operation, and Validation)
William V. Collentro, Interpharm Press, Inc., Buffalo Grove, IL, USA; 1998, 682 pages, US$ 179; ISBN: 1-57491-027-2

A number of publications have covered various aspects in the design, operation, maintenance and validation of pharmaceutical water systems. As Collentro notes in the preface, his intention was to present the whole subject methodically in a single book in order to improve the vertical and horizontal knowledge of operators, supervisors and managers on all levels. In addition the author, who is a chemical engineer with extensive field experience in pharmaceutical water purification systems, emphasizes the coordination of the engineering aspects with regulatory requirements. The text is carefully written in a concise style and consists of 13 chapters each with numerous, well updated references.

At first the USP definitions and requirements for pharmaceutical water qualities are presented. These specifications and the nature, type and concentration of impurities found in raw water define the water purification systems as briefly described in chapter 2. Subsequently selected water purification units used for pretreatment prior to ion removal are presented. A proper pretreatment scheme can determine the ability of a pharmaceutical water purification system to meet chemical and microbiological requirements. Accordingly, several pretreatment techniques are discussed in detail regarding their theory and application, design, operating and maintenance considerations. The following chapters 4–6 provide all technical aspects of ion removal techniques: ion exchange, reverse osmosis, electrodialysis, electrodialysis reversal and electrodeionization. Again, useful design and operating considerations and numerous case studies allow the reader to become familiar with these methods. Chapter 4 addresses specific ion exchange applications such as water softening, two-bed, fixed resin bed and mixed bed deionization or cation polishing. Chapters 5 and 6 provide a comprehensive survey of reverse osmosis and other ion removal techniques. There follows a chapter dealing with the important processes in production of water for injection. The basic principles of most of the commercially available distillation units, pure steam generators and condensing units are summarized together with informative data tables and schematic figures. In chapter 8 numerous critical items for storage system and related accessories in pharmaceutical water systems are discussed. Not only size, dimensions, orientation, heat transfer or internal finish of a storage tank are important, but the author also reminds us to carefully consider spray ball systems, control devices, fittings, tank pressure, hydrophobic vent filtration, etc. An excellent description of additional components for a pharmaceutical water system like in-line ultraviolet units, final membrane filtration, ultrafiltration and ozone treatment is given in chapter 9. The author uses the term 'polishing components' for these various unit operations and balances their pros and cons based upon his personal experience. The next chapter is dedicated to design, installation and material selection of distribution systems. Many drawings, parameter tables and material information may help to avoid mistakes in loop assembly or distribution piping. Personally, chapter 9 appears to be misplaced between storage and distribution systems, which are related and closest to the individual points of use. Chapter 11 presents a general overview of instrumentation, monitoring and control issues frequently encountered in pharmaceutical water purification systems. Specific indicators and other control elements including in-line conductivity and TOC measurements for pharmaceutical water purification systems are briefly discussed rather than a thorough control philosophy developed. Some general items which should be included in component and non-component specifications are presented in chapter 12. Collentro offers specification examples for a hot water sanitizable, activated carbon unit and the installation of a stainless steel distribution system, all details are listed in two extensive appendices. The last chapter of this book describes the validation process of pharmaceutical water purification systems, which itself could generate an entire separate volume when discussed in detail. This is taken into account throughout the book by numerous cross-references to the different validation steps, e.g. design, installational and operational qualification. A general discussion is followed by a few examples of complete validation proto-

cols and reports, which need to be adopted to your own procedures and templates.

As reflected by the number of pages the book covers most of the issues important for pharmaceutical water systems. It provides a comprehensive basis which is useful for industrial scientists from engineering, manufacturing, quality control and other departments involved. Unfortunately, the volume focuses on US standards and requirements but misses some international references, e.g. EP or JP monographs, PIC regulations and ISPE Baseline® guides. In a second edition, the table of contents should be more detailed and thus be more helpful for readers who want to search for selected information on specific points of interest. In addition, a glossary with abbreviations, units and conversion tables could be added. Of course, to keep up to date with new developments and the unique requirements of pharmaceutical water systems, one still needs to attend conferences or workshops and stay with research articles in the literature.

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