Books

CASTI Guidebook TO ASME B31.3 Process Piping (2nd Edition)

Glynn F. Woods and Roy B. Baguley
CASTI Publishing, Edmonton, Alberta, Canada, and McGraw-Hill, New York, 281 pp. $150, indexed, 1999

The ASME B31.3 Process Piping Code provides a minimum set of rules for the design, materials of construction, fabrication, testing, and examination practices used in the construction of process piping systems in chemical process industries (CPI) plants. However, B31.3 offers little explanation with respect to the basis or intent of the Code's rules. This book's aim is to develop an understanding for the user of B31.3 of the basis and intent of the Code rules. The book includes supplementary information that the Code does not specifically address, and the purpose of this information is generally to enhance the Code user's understanding of the broad scope of process piping design, materials selection, fabrication, testing practices, and examination methods.

Mr. Woods has been an active member of the B31.3 subcommittee since 1979, and Mr. Baguley, a metallurgical and welding engineer with wide international experience in this field, has been involved with the application of the Code in many different countries. In addition, they have availed themselves of the assistance of 13 other piping specialists in the preparation of this book.

The book contains nine chapters, six appendixes, a subject index, and a Code paragraph index (which is very helpful in locating specific paragraphs in the Code). The book covers the 1999 Code edition.

Chapter 1 is an introduction covering the history of the piping and vessel codes in the U.S., the scope of B31.3, and definitions of key terms and conditions used in piping design. It is noted that as of the March 1996 edition of the Code, B31.3 uses the metric system of measurement. In Chapter 2, the authors discuss the fundamentals of pressure design of piping and piping components (elbows and bends, branch connections, closures (heads or caps), flanges, and expansion joints).

Flexibility analysis of piping systems is thoroughly covered in Chapter 3. The topics discussed include: which piping systems require analysis, allowable stress range, displacement stress range, sustained load stress, occasional load stresses, methods to increase flexibility, and pipe supports. This chapter is very well written and makes a sometimes difficult subject more readily understandable by its use of illustrative example problems. Chapter 4 very briefly reviews limitations on piping and components, namely, fluid service categories (normal fluid service, Category D fluid service, Category M fluid service, and high-pressure piping), and severe cyclic conditions. Piping materials are discussed in Chapter 5, covering material classification systems and specifications (generic designations, designations according to the American Iron and Steel Institute, the Alloy Castings Institute, the Aluminum Association, the unified numbering system (UNS), and common ASTM carbon steel piping materials), material requirements for B31.3 piping (fluid service categories and materials), materials selection (legal, B31.3 Code, commercial, and technical considerations; conceptual, process and mechanical design considerations), and material certificates. Chapter 6 reviews many aspects of fabrication, assembly, and erection. The topics discussed are: bending and forming; welding; joints, base metals; filler metals; welding positions; preheat and interpass temperature; gases for shielding, backing, and purging; cleaning; workmanship; mechanical testing; and heat treatment. Inspection, examination, and testing of process piping systems are reviewed in Chapter 7. Discussions include inspection vs. examination, personnel requirements, examination, acceptance criteria for visual and radiographic examination, and testing. This is a thorough and good coverage of the subject.

> This book will be especially useful to neophyte process piping design engineers, and even to experienced old timers.

Chapter 8 is an excellent overview of piping design for Category N fluid service (toxic fluids). Subjects discussed include: design conditions (design temperature and pressure, impact and vibration design conditions, allowable stresses/allowances for pressure design); pressure design of metallic piping components (pipe wall thickness for internal and external pressure; limitations on metallic pipe, pipe fittings, and bends; and general restrictions on metallic valves and specialty components; flexibility and support of metallic piping; pressure relieving systems; metallic piping materials; fabrication and erection of Category M fluid service piping; inspection, examination, and testing of metallic Category N fluid service piping.

The final chapter reviews high-pressure piping systems design. This pertains to piping systems where the design pressure of a particular piping system is higher than that which an ASME B16.5 Class 2500 flange can safely con-

tain. Discussions include: scope and definition, modified base code requirements for high-pressure piping, and flexibility and fatigue analysis of high-pressure piping.

The six appendixes cover the following subjects: American Welding Society (AWS) specification titles, classification examples, and explanation; engineering data (list of ASME piping codes; list of ASME Boiler and Pressure Vessel Code sections; dimensions of welded and seamless pipe; conversion factors; SI prefixes; approximate hardness conversion numbers for nonaustenitic steels; approximate hardness conversion numbers for austenitic steels; approximate hardness conversion numbers for nickel and high-nickel alloys); international standards organizations and technical associations and societies list; expansion coefficients for metals; simplified stress calculation methods; and pipe size and pressure class for metric conversion.

This book, in my opinion, will be especially useful to neophyte process piping design engineers, and even to experienced old timers in this field. It is lucid in its discussions and presents a difficult subject in an easily understood manner. Its many illustrations and example problems (both in metric and U.S. units) greatly enhance its usefulness. I highly recommend it to all engineers involved in process piping design.

Stanley S. Grossel

S. S. Grossel is president of Process Safety & Design, Inc., Clifton, NJ.

Refining Overview – Petroleum, Processes and Products

Freeman Self, Ed Ekholm, and Keith Bowers
AIChE-South Texas Section and Fuels and Petrochemicals Divisions
CD-ROM, $30, 2000

"Refining Overview-Petroleum, Processes and Products," presented in the CD-ROM format, is an introductory survey of petroleum refining, its history, processes, feedstocks, and products. It is written in clear language with an easy-to-follow structure, and was based on a series of short courses presented in the late 1990s by the South Texas Section of AIChE.

"Refining Overview" is organized into four parts: feeds and products, history, processes, and references, each of which are broken down into individual chapters.

Part One, separated into three chapters, describes crude oils, internal refinery streams, and products, along with characteristics of their respective fractions, grades, and specifications, and appropriate sources for obtaining more information on each of these. Although, on an occasion or two, the reader might wish for more detailed tables of product specifications, particularly on the admittedly influx RFGs, the absence of such detail is understandable in light of the excellent sourcing and the fact that this is a survey book, and quite made up for by the encyclopedic inclusion of such delightful rarities as "road oil." The charts here, as with the rest of the book, are excellent, and at times justifiably repetitive for the sake of logical clarity.

Part Two (Chapters 4–8) reviews the history of the refining industry, particularly as developed in the U.S., albeit giving reflection to the impact of global events. The discussion begins with what is termed the "primitive" period (pre-1910) with mid-nineteenth century discoveries and developments, leading to very simple distillation plants producing kerosene and lubricants as their main valuable products. Photographs of certain artifacts of the era are included, among them the cover of an 1855 report by Yale Prof. Benjamin Silliman and one of Samuel Kier's early batch stills. This reader found himself following the early history with enthusiasm.

The advent of the electric light and early automobiles marked the end of the primitive era by reducing the market for kerosene and providing one for gasoline (up to then a low-value byproduct) and brought about advances in thermal refining processes. This period, lasting until about the Second World War, saw the development of thermal cracking, as well as thermal reforming and polymerization processes, and the utilization of tetraethyl lead.

The explosive post-WWII growth in the motor gasoline market, as well as the need for higher octane aviation gasoline, led to the golden era of catalytic processes. The key process of this period was, no doubt, gasoil cracking, beginning with the Houdry process, and then flluid catalytic cracking, and, later yet, the advent of molecular sieve catalysts in the 1960s. Other major processes developed and commercialized during the this period include the octane-improving catalytic reforming (starting with the I. G. Farben process and then revolutionized with the UOP platinum catalyst), catalytic polymerization, isomerization, and alkylation. Certain thermal processes, such as coking and visbreaking, also saw developments during this time.

The modern, post-embargo refinery is very much driven by matters related to energy efficiency, safety, and environmental issues, and has led to great hardware, operations, and catalyst-related developments in many processes. Key among these processes are hydrocracking and hydrotreating.

The bulk of "Refinery Overview" is contained in Part Three, consisting of 19 chapters (9–27), primarily on various individual processes. Conceptually, the authors stress three general functions of the refinery: gasoline manufacturing, aromatics manufacturing, and resid processing.

Each function is introduced with its own overview chapter, and then, in the cases of gasoline and resid, examined more closely with chapters describing the individual process units associated with this function. The topics are organized, more-or-less, from the top to the bottom of the barrel, and so they begin, after atmospheric distillation, with light ends upgrading, isomerization, reforming, and progress to the vacuum resid processing units such as visbreaking, solvent deasphalting, and heavy-end specialty products.

In the overview chapters, the gasoline manufacture chapter stresses performance and emissions criteria, the impact of gasoline characteristics in meeting these criteria, and component stream blending. The aromatics manufacture overview provides several schematics and descriptions of various relevant processes including extraction, toluene hydrodemetallation and disproportionation, xylene isomerization, and several precision fractionation processes. The resid upgrading overview chapter discusses the modern need for resid upgrading, introduces the processes (to be detailed in the chapters to follow), and reviews some configuration combination options.

"Refining Overview" is a clearly written and attractive self-teaching survey book for new and seasoned ChEs.

The chapters on the individual process units have clear and similar structures. First, the process objective is described and the history of its development is reviewed. Then, the authors review the feeds and products of the unit and provide very general rule of thumb yields. A brief discussion of the chemistry is then introduced, as necessary, including some basic formulas, followed by a qualitative description of process variables and how the process is controlled (*e.g.*, higher pressure increases catalyst life, but also increases side reactions in an isomerization unit). The process is then described using typical schematics, along with perhaps one or two alternative arrangements. When appropriate, such as with reforming and alkylation, catalyst regeneration strategies are described. Finally, the authors point out some recent trends in the development of the particular process unit. The importance of hydrogen in the modern refinery is acknowledged by the inclusion of a chapter on hydrogen use.

The last chapter in Part Three contrasts the hydroskimming refinery with the complex refinery, introduces the concepts of cost ratio and complexity factor, and provides rule-of-thumb numbers for individual process units and for refineries in different regions of the world.

The last section of the book, Part Four, contains source references for additional information and data on individual topics. The topics are directly related to the previous parts and, in many cases, contain Web site hypertexts.

A word about the package. The book is painlessly installed from the CD-ROM, requires the freely-available Acrobat Reader (which is at any rate provided), and works within the usual Microsoft Windows graphical user interface. The design is visually attractive and inviting, and moving back and forth from pages and chapters to one another is intuitive. The (extensive) index is good, particularly as it is hypertexed. The search capability, though promising and potentially a key benefit when compared with hardcopy books, appeared to return incomplete results only. For example, a search for the word "sulfur" missed an entire key section in Chapter One, regardless of the search criteria imposed. This is a drawback which I expect can be easily fixed by the authors.

In summary, "Refining Overview" is a clearly written and attractively packaged self-teaching survey book most appropriate as a quick reference source for the practicing refining professional, or as a training text for nonrefining chemical engineers or those starting in the field, and engineers and scientists from other disciplines. This book could also serve as the central text in an introductory university course, perhaps in combination with another text such as "Petroleum Refining" by Gary and Handwerk to introduce quantitative analysis of refinery operations and economics.

Iraj Isaac Rahmim, PhD

I. I. Rahmim heads E-MetaVenture, Inc., Houston.

You can order directly from the South Texas Section Web site: www.sts-aiche.org.

Geostatistical Error Management: Quantifying Uncertainty for Environmental Sampling and Mapping

J. C. Myers
Van Nostrand Reinhold, New York, 571 pp., $110, 1997

All chemical engineers should have some knowledge of sampling practice and theory as it relates to environmental issues. It is highly probable that during the career of any given chemical engineer, he or she will be involved in an environmental issue involving soil samples. Prior to plant construction, soil samples should be taken to characterize the site. Soil samples may be taken around the boundary of a plant during its operational life. This is particularly true about tank farms. And, of course, soil sam-

ples may be taken after plant decommissioning to characterize soil quality after using the site for production of chemicals. A sampling error in any of these exercises can be highly costly to a chemical company. And that cost increases nearly exponentially with sampling error. Thus, the title of this book: "Geostatistical Error Management: Quantifying Uncertainty for Environmental Sampling and Mapping" (GEM).

GEM is a book about statistics. But, compared to other statistics books, it is significantly different. It is much more verbal than mathematical. The author, Mr. Myers, explains the results of mathematical statistics rather than deriving those results.

GEM is divided into six parts. These are: introduction to geostatistical error management; statistical considerations; sampling theory and practice; geostatistical appraisal; data quality objectives; and appendices.

There are two chapters in Part One. The first describes the foundations of geostatistical error management and the second chapter explains the importance of managing sampling error for environmental projects and for mine valuation projects. These chapters also discuss what is required for a map to be trustworthy.

Part Two contains chapters covering the foundation of statistics, data distributions, and distribution models. In these chapters, the author explains, verbally, concepts requiring pages of mathematical symbols in similar books.

Mr. Myers presents the concept of heterogeneity and sampling error in Part Three of his book. The fundamental error equation for sampling is discussed in this section. This is one of the best presentations of the fundamental error equation that I have come across.

Part Four is entitled "Geostatistical Appraisal" and contains six chapters. These chapters discuss bivariant distributions, variograms, volume-variance relationships, estimation variance, estimation optimization by kriging, and the practical aspects of kriging.

Part Five outlines the issues of data quality objectives. Data quality objectives relate directly to fulfilling the needs of the various government agencies involved with permitting and site reclamation. Providing these agencies with data that meets their needs and doing the sampling program once is a method of defining quality. Otherwise, the sampling program will be repeated, at additional expense to the chemical company. Basically, quality data comes from understanding what the various government agencies need and want.

Appendices comprise the final part of this book. There are three appendices. The first provides definitions for the terms used in sampling theory. The second discusses the mathematical expressions describing heterogeneity. And the third appendix derives the fundamental error equation for sampling.

The outlay of many millions of dollars depends upon the environmental map developed for a chemical production site from a soil sampling program. The quality of that map depends on the quality of the soil sampling program. Environmental consulting firms generally conduct the sampling program. However, a plant chemical engineer will supervise that consulting firm. GEM provides a good foundation of geostatistics sampling theory and practice for the chemical engineer interfacing with an environmental consulting firm.

Jonathan H. Worstell

J. H. Worstell is a staff research chemist/engineer with Shell Chemical Co., Houston.

Topics in Chemical Engineering Volume 10: Thermal Processing of Biomaterials

Edited by T. Kudra and C. Strumillo
Gordon & Breach Publishing, Newark, NJ, 654 pp., $115, 1998

This book addresses an important and difficult area in the processing of biomaterials, and in so doing attempts to bring the rigors of heat and mass transfer from engineering to the heterogeneous, highly sensitive materials and products from biotechnology.

The book is divided into eight parts, starting in Part One with review chapters on the properties of biomaterials that set them apart from the materials usually handled by the process engineer. It is highly significant to me that in these chapters only two short sections describing specific heat and thermal conductivity give the reader some hard numbers that could be used in process calculations. This is no fault of the authors, as it seems that the whole area of defining the thermal properties of biomaterials is neglected — is it too difficult or not important?

Parts Two, Three, and Four deal with processing by temperature elevation, temperature reduction, and drying, respectively. These chapters cover equipment and process calculations in a conventional, but thorough, manner. Parts Five and Six detail newer or novel thermal processing techniques with special reference to the preservation of bacteria and enzymes.

Part Seven, which deals with bioreactors, does not fit well with the other parts in my opinion, but the book finishes strongly with a final section covering safety and loss prevention when thermally processing biomaterials.

Overall, the book is packed with tables, graphs, and photographs of equipment which, together with many references, make it a source of ideas for research and teaching.

George M. Hall