Feedstock Recycling and Pyrolysis of Waste Plastics, J. Scheirs, W. Kaminsky (Eds.). John Wiley & Sons Ltd., Chichester, West Sussex, England (2006). 815 pp., Price: US$ 360.00, ISBN: 0-470-02152-7

Plastics comprise a major fraction of municipal solid wastes. According to Aguado et al., in their chapter entitled "Catalytic Upgrading of Plastic Wastes," in 2002 the total plastic consumption in western Europe was 38.1 million tonnes of which 24 million tonnes were collected. They note that the main components of plastics in the household waste stream are polyolefins, linear low-density polyethylene, high-density polyethylene, polypropylene, polystyrene, polyvinylchloride and polyethylene terephthalate.

Unfortunately, most plastics are nondegradable (with only 15–20% that can effectively by recycled) and require considerable time to break down in landfills, consuming valuable space.

Plastic pyrolysis (which can handle mixed, unsorted, unwashed plastics) involves thermal degradation at temperatures in the 400–600 °C range in the absence of oxygen. During pyrolysis, the plastics are heated to a high temperature at which their macromolecular structures are broken down to smaller molecules yielding a wide range of hydrocarbons in a process that, since it does not involve incineration, produces no toxic or harmful emissions. Given the dual societal concern for waste disposal and fuel scarcity, this book is a "hot topic" publication.

In the initial chapter, Buekens of Vrije Universiteit Brussel provides an overview of the topic focusing ". . .on some technical and practical aspects of pyrolysis or thermal cracking of waste plastics to yield liquid fuels and monomers as a main product." Of note in his references is a list of numerous useful (print) publications and Internet web sites.

The second chapter goes into the basics of the problem. White of the University of Oklahoma notes that "Future development of effective plastic waste recycling methods that involve catalytic cracking will require detailed knowledge of the relationship between cracking conditions and product distributions." In his chapter, White describes the primary reaction mechanisms that occur in the acid-catalyzed cracking of polyolefins.

In Chapter 3 (noted earlier) Aguado et al. discuss the various types of reactors used for the catalytic upgrading of plastic wastes. Reactor types discussed include: batch/semi-batch, fixed bed, fluidized bed, spouted bed, and screw kiln. Process flow diagrams are given followed by a discussion of operating variables, processes, and related technology.

The book is fascinating and the topic is exceedingly relevant to current environmental concerns. I wish space permitted to review in depth every chapter as I have done for the first three, although I fear that I could not retain reader interest in such a lengthy review. The book is well written and contains a wealth of information on current and proposed plastic waste technologies. Much information is given on the current art of waste plastics processing. That information includes numerous flow and equipment diagrams and experimental results for currently active research projects and the data resulting therefrom.

I think best way I can illustrate the contents of the book (albeit inadequate) is to list the chapters, which are as follows:

- INTRODUCTION
  1. Introduction to feedstock recycling of plastics
- CATALYTIC CRACKING
  2. Acid-catalytic cracking of polyolefins: primary reaction mechanisms
  3. Catalytic upgrading of plastic wastes
  4. Thermal and catalytic conversion of polyolefins
  5. Thermal and catalytic degradation of waste HDPE
  6. Development of a process for the continuous conversion of waste plastics mixtures to fuel
  7. Catalytic degradation of plastic waste to fuel over microporous materials
  8. Liquefaction of municipal waste plastics over acidic and nonacidic catalysts
  9. Kinetic model of the chemical and catalytic recycling of waste polyethylene into fuels
- QUALITY OF FUELS
  10. Production of gaseous and liquid fuels by pyrolysis and gasification of plastics; technological approach
  11. Yield and composition of gases and oils/waxes from the feedstock recycling of waste plastic
  12. Composition of liquid fuels derived from the pyrolysis of plastics
  13. Production of premium oil products from waste plastic by pyrolysis and hydroprocessing
  14. The conversion of waste plastics/petroleum residue mixtures to transportation fuels
- REACTOR TYPES
  15. Overview of commercial pyrolysis processes for waste plastics
  16. Fluidized bed pyrolysis of plastic wastes
  17. The Hamburg fluidized bed pyrolysis process to recycle polymer wastes and tires
  18. Liquefaction of PVC mixed plastics
  19. Liquid fuel from plastic wastes using extrusion—rotary kiln reactors
  20. Rotary kiln pyrolysis of polymers containing heteroatoms
  21. Microwave pyrolysis of plastic wastes
  22. Continuous thermal process for cracking polyolefin wastes to produce hydrocarbons
  23. Waste plastic pyrolysis in free-fall reactors
- MONOMER RECOVERY
  24. Monomer recovery of plastic waste in a fluidized bed process
  25. Feedstock recycling of PET
- ASIAN DEVELOPMENTS
  26. The liquefaction of plastic containers and packaging in Japan
  27. Process and equipment for conversions of waste plastics into fuels
  28. Converting waste plastics into liquid fuel by pyrolysis: developments in China

This book is excellent. It treats an extremely important topic in great detail with an impressive list of contributions from all over the world (46 contributors from 18 countries). It is a tremendous compilation of the state-of-the-art of pyrolysis of waste plastics. Anyone interested in the field must consult this text.

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Fundamentals of Environmental Sampling and Analysis, C. Zhang. John Wiley & Sons, Inc., Hoboken, NJ (2007). 456 pp., Price: US$ 99.95, ISBN: 978-0-471-71097-4

In the preface, Zhang clearly articulates the need for information in this book by stating:

> "The acquisition of reliable and defensible data through proper sampling and analytical techniques is often an essential part of the careers for many environmental professionals."

And to satisfy this need, Zhang has authored this book whose

> "...overall objective...is to introduce a comprehensive overview on the fundamentals of environmental sampling and analysis for students in environmental science and engineering as well as environmental professionals who are involved in various stages of sampling and analytical work."

The author notes that his goal was to produce a book focusing on "why" rather than "how." In my opinion, he has done this well. However, those looking for description of "how to" techniques will not be disappointed as there is much information in the book.

Zhang describes the content of the book as follows:

> "Chapter 1 starts with an overview on the framework of environmental sampling and analysis and the importance for the acquisition of scientifically reliable and legally defensible data. Chapter 2 provides some background information necessary for the readers to better understand the subsequent chapters, such as review on analytical and organic chemistry, statistics for data analysis, hydrogeology, and environmental regulations relevant to sampling and analysis. The following two chapters introduce the fundamentals of environmental sampling - where and when to take samples, how many, how much, and hot to take samples from air, liquid, and solid media.
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> Chapter 5 introduces the standard methodologies by the US EPA and other agencies. Their structures, method classifications, and cross references among various standards are presented to aid readers in selecting the proper methods. Quality assurance and quality control (QA/QC) for both sampling and analysis are also included in this chapter as a part of the standard methodology. Chapter 6 provides some typical operations in environmental laboratories and details the chemical principles of wet chemical methods most commonly used in environmental analysis. Prior to the introduction to instrumental analysis and applications in environmental analysis in Chapters 8–12, various sample preparation methods are discussed and compared in Chapter 7.
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> In Chapter 8, the theories of absorption spectroscopy for qualitative and quantitative analysis are presented. UV-visible spectroscopy is the main focus of this chapter because nowadays it is still the workhorse in many of the environmental laboratories. Chapter 9 is devoted to metal analysis using various atomic absorption and emission spectrometric methods. Chapter 10 focuses on the instrumental principles of the three most important chromatographic methods in environmental analysis, i.e., gas chromatography (GC), high performance liquid chromatography (HPLC), and ion chromatography (IC). Chapter 11 introduces the electrochemical principles and instrumentations for some common environmental analysis, such as pH, potential titrations, dissolved oxygen, ion selective electrodes, conductivity, and metal analysis using anodic stripping voltammetry. Chapter 12 introduces several analytical techniques that are becoming increasingly important to meet today's challenge in environmental analysis, such as various hyphenated mass spectrometries using ICP/MS, GS/MS and LC/MS. This last chapter concludes with a brief introduction nuclear magnetic resonance spectroscopy (less commonly used in quantitative analysis but important to structural identifications in environmental research) and specific instrumentations including radiochemical analysis, electron scanning microscopes, and immunoassays."

The reader of this review will, I am sure, agree with me that all aspects of environmental sampling are well covered. I was particularly interested (from my personal perspective) in a discussion of the dissolved oxygen electrode which I utilized in my own research more than 50 years ago. I was surprised by a discussion of air sampling equipment and sampling techniques in a book that deals mainly with water. The discussion of air sampling was not extensive, but it was useful. Another useful inclusion was a succinct summary of US environmental laws.

Other very beneficial aspects of the book include:

- copious, excellent equipment diagrams;
- QA/QC discussion;
- introduction of advanced analytical techniques such as various hyphenated mass spectrometries and nuclear magnetic resonance spectroscopy;
- approximately 25 questions and problems for student assignment in each chapter;