nants, the problems they pose and potential solutions thereto. This they have done in the following chapters:

Part I: Fundamentals of Biotic and Abiotic Interactions of Metals and Metalloids with Soil Components:

- Impacts of physicochemical–biological interactions on metal and metalloid transformation in soils: an overview
- Transformation and mobilization of metals, metalloids, and radionuclides by microorganisms
- Kinetics and mechanisms of sorption–desorption in soils: a multiscale assessment
- Spectroscopic techniques for studying metal–humic complexes in soil
- Factors affecting the sorption–desorption of trace elements in soil environments
- Modeling adsorption of metals and metalloids by soil components

Part II: Transformations and Dynamics of Metals and Metalloids as Influenced by Soil–Root–Microbe Interactions

- Biogeochemistry of metals and metalloids at the soil–root-interface
- Biogeochemical processes controlling the cycling of arsenic in soils and sediments
- Microbial oxidation and reduction of iron in the root zone and influences on metal mobility
- The complexity of aqueous complexation: the case of aluminum- and iron(III)-citrate

Part III: Speciation, Mobility, and Bioavailability of Metals and Metalloids and Restoration of Contaminated Soils

- Chemical speciation and bioavailability of trace metals
- Fractionation and mobility of trace elements in soils and sediments
- Sources and mobility of metallic radionuclides in soil systems
- Remediation of metal-contaminated soils: an overview
- Phosphate-induced lead immobilization in contaminated soils: mechanisms, assessment, and field applications

Huang, author of the first chapter, concludes it in the following way:

"Fundamental understanding of soil physical, chemical, and biological interfacial interactions at the molecular level is essential to understanding the behavior of metals and metalloids in the pedosphere and to restoring terrestrial ecosystem health on the global scale. Future research on this extremely important and exciting area of science should be stimulated to sustain and enhance ecosystem productivity, services, and integrity and the impact on human health and prosperity."

While the science underlying soil metal problems is of great importance, because of my engineering background, I was more interested in solutions to the problem; that was the topic of Section III. Of the five chapters (listed above) in this section, I have chosen to review the fourth (Remediation of Metal Contaminated Soils: An Overview) by Grafe and Naidu. Written by two Australians, the authors review the bioavailability of metals in soils before they discuss remediation technologies. Remediation is discussed in some detail. Technologies employed it this activity include bioremediation, phytoremediation, electrokinetics, in situ soil flushing, monitored natural attenuation, solidification and stabilization, in situ capping, excavation, soil mixing, incineration and vitrification.

The authors discuss each of the above noted processes briefly but in sufficient detail to understand the techniques and their applications. They note that "... apart from the soil washing process, the other techniques are not yet fully developed and where these have been tried, the duration of the remediation process has been long." This section concludes with a list of the major challenges facing scientists dealing with remediation of metal-contaminated soils:

- "Development of analytical technology for subsurface assessment
- Development of in situ remediation technology that is cheap, effective, and rapid
- Development of an integrated physical, chemical, and biological remediation process
- Remediation of subsurface metal-contaminated soils
- Development of technology for remediation of mixtures (i.e., site contaminated with metals, metalloids, and organics)
- Fundamental process modeling and verification
- Developing genetically engineered microorganisms and genetically modified plants to detoxify metals in contaminated soil
- Enhancement of natural remediation processes"

This book is an important contribution to the literature on soil contamination by metals and its remediation.

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27 March 2008

Available online 8 April 2008

doi:10.1016/j.jhazmat.2008.03.124

Fundamentals of Industrial Catalytic Processes, C.H. Bartholomew, R.J. Farrauto., 2nd edition, John Wiley & Sons Inc., Hoboken, NJ (2006). 993 pp., 8 1/2 × 11 in. format, Price: US$ 99.95, ISBN: 978-0-471-45713-8

> In this second edition [the authors write] we continue our initial concept, namely, that of a combined textbook that marries the fundamentals of catalysis with practice.

And they have done that well in this book slated for use by students and practicing professionals, both chemists and chemical engineers.

> The book is organized into two parts containing altogether 13 chapters. The first part, Introduction and Fundamentals, contains five chapters dealing with: (1) fundamentals of catalysis; (2) catalyst materials, properties and preparation; (3) catalyst characterization; (4) reactors, reactor design, and activity testing; and (5) catalyst deactivation. The second part, Industrial Practice, includes eight chapters treating: (6) hydrogen production and synthesis processes; (7) hydrogenation and dehydrogenation processes; (8) oxidation processes; (9) petroleum refining and hydrocarbon processing; (10) environmental control of mobile sources; (11) environmental control of stationary sources; (12) homogeneous, enzymatic and polymerization catalysis; and (13) fuel cell catalysis.

The authors begin with a short discussion of the history of catalyst technology. They report that the word 'catalyst' was coined by

Berzelius in 1836, but work in the field had begun in the early 1800s by Berzelius, Davy, Faraday and others. A lengthy table contains historic data on the development of important industrial chemical processes. The first process listed was in 1875 when sulfuric acid was manufactured; the last process discussed in the table was in the 1980–1995 time period and was the selective catalytic reduction of NO.

The above area of catalyst use takes us to Chapter 10 titled "Environmental Catalysis: Mobile Sources" where three major uses of catalytic devices are discussed: automobiles (gasoline engines), diesel engines, and ozone abatement in high-flying aircraft. Automotive catalytic converters are ubiquitous in North America. Early (but experimental) catalysts employed were Pt and Pd. The authors discuss the development process and ultimate design of catalytic converters. Both theory and practice are covered. Looking to the future, the authors discuss diesel emission abatement. In this discussion, they review catalyst systems for ozone abatement on high-flying commercial aircraft.

The following chapter deals with stationary source environmental catalysis. A major use of catalytic systems is for the elimination of NO_x problems resulting from the combustion of fuels in boilers, engines and turbines. Two major systems are discussed in detail: (1) non-selective catalytic reduction and (2) selective catalytic reduction. I was surprised to learn that noble metals were employed in catalysts as long as 50 years ago. Incorporation of SCR into power plant emissions is shown for high dust, low dust and tail end systems.

Another important use of catalytic systems – the destruction of hydrocarbons (VOCs) – follows the NO_x discussion. Examples of processes emitting VOCs are paint bake ovens, chemical coating of cans, paper and fabrics, metal coating operations, chemical plant processes, printing, textile plants and electronic plants. Several reactor configurations for emission abatement are shown, two of which illustrate heat recovery. The next segment of the chapter deals with CO oxidation.

A short section of personal interest was entitled "Catalytic Abatement of Emissions from Wood Stoves." This was of interest to me because I purchased such a system many years ago for my cottage. This system is reported to achieve creosote removals of 85–95%, CO removals of 90% and a significant decrease of PM 2.5 (particles smaller than 2.5 μm in diameter). The system's life typically is two heating seasons.

The current "hot topic" on the environmental scene is Green Chemistry. While not treated exhaustively in this book, it is introduced late in Chapter 11. Catalysts are, the authors note, "...a major tool for successful green chemistry because it enhances production, efficiency, and minimizes waste..." with such applications as in water purification, gas masks, mosquito killing, etc.

The second to last chapter is entitled "Homogeneous, Enzyme, and Polymerization Catalysis." Given that all the previous chapters deal with industrial/chemical systems, I was surprised at the inclusion of this topic, but I was delighted to see it because of the importance of enzymatic reactions. There are approximately 3000 known enzymes. Enzyme catalytic reactions are termed biocatalysis, a process which can occur inside or outside a microorganism. The field has been rapidly expanding over the last 15–20 years. Numerous examples of industrially important enzymes are given, among which were glucose isomerase (fructose syrup production), penicillin amidase (antibiotics) and rennin (cheese production).

The last chapter (like the previous one) covers a new area—hydrogen production and fuel cells catalyst technology. Hydrogen production traditionally involved catalytic processes but new avenues are being developed including the proton exchange membrane fuel cell, alkaline electrolyte fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell and direct methanol fuel cell.

A 13-page glossary of terms completes the book which I note has approximately 300 figures used to illustrate the authors' main points. The authors also include recommended sources for further study and exercises for student assignment. These exercises include both recommended reading and essay questions as well as numerical problems.

Comprehensive, clear, well-written and well-illustrated are a few of the terms I must use to describe this monumental work. In addition, copious use of appropriately sized diagrams and tables are used as well as a plethora of references.

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31 March 2008

Available online 6 April 2008

doi:10.1016/j.jhazmat.2008.03.134