Preface

We are becoming increasingly aware of the overwhelming pollution of our limited water resources on this planet. And while many contaminants originate from Mother Earth, most water pollution comes as a direct result of anthropogenic activities. This problem has become so immense that it threatens the future of all humanity. If effective measures to reduce and/or remediate water pollution and its sources are not found, it is estimated by UN that 2.7 billion people will face water shortage by 2025 as opposed to 1.2 billion people who do not have access to clean drinking water now. Therefore, development of novel green technologies to address this major problem represents a priority of the highest importance. This book discusses green chemistry and other novel solutions to the water pollution problems which includes some interesting applications of nanoparticles.

Discussion in Chapter 1 is focused on an important problem relating to arsenic contamination of groundwater, which affects nearly 200 million people in various countries, including advanced countries like the United States. Two green chemistry solutions are offered to remediate this horrendous problem. Chapters 12 and 13 discuss some other novel solutions to the problem.

Advanced oxidation and reduction processes, which can be used successfully to remediate water contaminants through the creation of highly reactive radical species are discussed in Chapter 2. Similarly, Chapter 3 illustrates the capacity of ferrate(VI) ion to treat antibiotics in water through an environment-friendly process that could perform a dual function of oxidation and disinfection, forming a nontoxic by-product, iron(III).

A cost-effective and readily accessible woodchip bioreactor for treatment of nitrate-contaminated groundwater below the US EPA maximum contaminant level of 10 mg/L NO_3-N is described in Chapter 4. Two different applications of another novel technology are illustrated in Chapters 5 and 6. These chapters demonstrate the use of zero-valent iron nanoparticles for prevention of mercury methylation and efficient in situ dechlorination of chlorinated solvents in groundwater.

Utilization of inexpensive polycations, as noncovalent bridges that tether anionic surfactant micelles to porous media such as silica or sand, to treat toluene and dichloroethane contamination is discussed in Chapter 7. Oligomerization is a cost-effective way to improve performance of activated carbon for water treatment applications (see Chapter 8).

An innovative concept for removal of heavy metals from acidic solutions utilizes cyclic electrowinning/precipitation is described in Chapter 9. This unique process allows rapid reduction of contaminants and efficient processing of large volumes of contaminated solutions. Removal of two of the most

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important micronutrients, nitrogen and phosphorus from wasterwater to prevent eutrophication and produce fertilizers, is discussed in Chapter 10.

Feasibility of using a coating of one or two layers that serves as a barrier between the membrane and foulant to reduce membrane fouling is discussed in Chapter 11. Chapters 12 and 13 describe development of hybrid nanoparticle-containing media for simultaneous treatment of multiple contaminants from water. Chapter 12 focuses on synthesis of a hematite nanoparticle granular activated carbon for removal of arsenic and organic co-contaminants. Similarly, Chapter 13 describes the development of an inexpensive and easy-to-fabricate titanium dioxide–based hybrid ion-exchange media and assesses its potential to remove arsenic and nitrate from water.

An overview of applications of zero-valent iron for removing a wide array of contaminants—ranging from microorganisms and chlorinated organic compounds to disinfection by-products and their precursors—is provided in Chapter 14. Chapter 15 demonstrates an application of a full-scale hybrid sequencing batch membrane bioreactor serving 400 residential units and discusses the factors impacting the optimum performance of this system.

We believe that *Novel Solutions to Water Pollution* is a useful and informative text for those engaged in issues of water quality and water pollution remediation at operational, administrative, academic, or regulatory levels.

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