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Analysis, technologies and implementation

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Preface

This book deals with the state-of-the-knowledge on the sustainable supply and use of water and material resources in industry. The contributions by leading experts in government, industries, and academia clearly illustrate that management approaches and technological options are interdependent and that both interact within the regulatory environment. The problems currently faced in water and material resources management depend on resource demands and supplies, their reliability and environmental protection which may be geographically varied and rather localised. Thus, the appropriate responses, both managerial and technological, will vary accordingly and creative thinking will be needed. Several chapters in this book contain such responses and illustrate them by case studies.

Our main objective in assembling the various chapters has been to present major state-of-the knowledge reviews of the closing industrial water and resource cycles in sustainable ways. Each separate chapter is presented on a stand-alone basis, so that the reader will find it helpful to consider only the theme of each chapter. There are nevertheless many connections among what may at first seem to be quite different subjects. It was our intention to draw out

and emphasize interdisciplinary linkages among different chapters. For this reason, a comprehensive index is provided to facilitate cross-referencing. We hope that the work described in this book will encourage those already working in the field and inspire those who are starting to explore this field in the context of sustainable water and resource cycles.

Worldwide, freshwater plays a vital role in the society. Many scientists believe that in this century, water will become an even costly natural resource as oil. In addition to meeting personal needs, water is also used for irrigation, as a coolant in industry and power generation, as a medium for industrial processes and by all users – agricultural, industrial and domestic – to wash and carry dirt and waste away. Groundwater resources constitute 60% of sources for public water supply systems which provide water for consumption and other sensitive uses. Yet, it is groundwater that is under long term threat of contamination from pollutants already “locked” into the soil.

Economic growth and development depends on the provision of adequate quantities of freshwater supplied to an acceptable quality. There are already many regions of the world where demand is outgrowing supply and thus, further development may be curtailed. This situation is getting more and more severe, due to the continuous growth of population and urban development. As competition for water resources increases, agricultural, industrial and domestic users have to find ways to mitigate their demands. Pressure to do so is increased by the competition between these major “off stream” users and the natural water resource system itself. There is now general agreement that the quality and quantity of water present in lakes, rivers and underground sources should be maintained to preserve aqueous eco-systems and their attractiveness and suitability for recreation. In addition, there are other “in stream” users such as navigation and hydro-electric generators that also place demands on the water resources.

The European Community’s water utilities spend approximately 14 billion Euro per annum operating their water supply and wastewater treatment services. Investments in water and wastewater treatment plant and equipment by the utilities and by industry amounted to some 20 billion Euro per annum in 1995. The total OECD wide market is estimated to be four times as large. These figures suggest that there are opportunities for cost savings by more effective use of water supply and treatment plants. They also indicate that there is a large market, worldwide, for companies to produce and supply equipment and services.

In resource management, quality is as important as quantity. Almost all of the water abstracted by the three main “off stream” users is eventually returned to the natural water course – with varying degrees of cleanliness. In many parts of

the world, the use of water resources is now so intense that the quantity and quality of water returned significantly affects all other users of the natural water system. For example, in the Thames river basin, water is abstracted, treated, used, collected as waste water, cleaned and then returned again to the river basin up to three times before it is finally no longer used for consumption. In the water chain, there are many shared rivers, lakes and groundwater reserves where one group's discharges form part of another group's supply. This growing interdependence increases the potential for accidents and spillages to have a widespread impact. Hence, the major users are under increasing pressure to markedly improve the efficiency of their waste(water) treatment and management.

Pollution prevention is necessary to maintain the water resource quality in the long term. Pollution prevention mainly depends on the development of cleaner technologies for industry and agriculture. However, prevention measures are not sufficient: it is equally important to generate technological solutions to correct existing pollution problems of historical origin and to deal with accidental pollution events that will continue to occur in the future.

Up to now, most research and development activities, regulations and economic policy measures applied to water and material resources management have been mainly towards problems of their supply. However, water serves a wide range of ecological and economic interests, including domestic, agricultural and industrial users, manufacturers of equipment and services as well as supply utilities. Sustainable management strategies will need to focus on controlling the demand for water as well as improving its supply. Technologies to improve the efficiency of water use in agricultural and industrial processes will be a critical element in demand reduction strategies. A major part of this book deals with system analytical tools and reactor technological solutions that allow industries to reduce their demand on water or material resources. The contributions illustrate that many of the technological advances related to improved resource management (e.g. automatic improvements and process control) and use (demand reduction, recycling and treatment) depend on the application and combination of generic technologies and techniques from many different scientific areas (materials science, biotechnology, operations research, energy and information technologies). Effective transfer of knowledge between these areas of technology is a significant challenge for the environmental engineering community in the next few decades.

Increasing public demands for improving water and material resource management will create significant pressure on industry to adopt innovative resource conservation methods and improve their technological competencies. This can be accomplished by defining the best practical techniques using either

technological means (e.g., adopting best available technologies) or financial instruments (e.g., water pricing and eco-taxes). A better understanding of the physical, social and economic interactions surrounding water or material resources management is, however, needed to develop effective methods that balance the competing demands among many users of water and resources. This book pays special attention to these interrelations for industrial production processes.

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