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Environmental Management of Solid Waste

Dredged Material and Mine Tailings

With 118 Figures

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Preface

Mine tailings and dredged materials are solid wastes, which are produced at single sites in huge quantities. Costs are dramatically increasing both for the installation of new disposal sites and for the restoration of former deposits, which had been planned and operated in an inappropriate manner. The problems and questions these waste materials pose with regard to safe environmental deposition are similar: aquatic versus terrestrial disposal, revegetation, leaching of contaminants. Larger projects in the fields of both mine tailings reclamation and dredged material disposal are increasingly requiring a multidisciplinary team approach. Scientists with many different backgrounds – engineers, hydrologists, geologists analytical chemists, biologists, ecologists, environmental planners and economists – are searching for long-term solution, which involve minimum harm to nature, but can still be paid by society.

A typical project (and one of the motives for this book) was the planning of the "sludge island" off Rotterdam. After one decade of preparatory research, which was continuously interacted by public discussions, the Port of Rotterdam and the Netherlands Waterways Administration has now started to construct a containment for approximately 150 million m^3 of moderately to strongly polluted dredged sludge from the harbor area. The various "ecological" advantages will be discussed in several contributions to the present work. This solution also seems to be economically competitive with the old inland sites and even to the sea disposal of dredged materials (!). It is noteworthy, however, that the Municipality of Rotterdam has definitely stated that there is no intention of creating further large-scale sites after 2002. Measures have to be undertaken to improve the quality of the sediments, particularly by municipal and industrial dischargers in the Rhine River catchment area.

Mine tailings, compared to the more recent environmental implications with dredged materials, have been recognized as problematic materials for a long time. A report from 1868 of the River Pollution Commission in Britain described the situation in mid-Wales: "All these streams are turbid, whitened

by the waste of the lead mines in their course; and flood waters bring down poisonous slime which, spreading over the adjoining flats, either befoul or destroy grass, and thus injure cattle and horses grazing on the dried herbage, or, by killing the plants whose roots have held the land together, render the shores more liable to abrasion and destruction on the next occasion of high water". Until now, problems arising from acid mine effluents are not satisfactorily solved in any part of the world. The major emphasis devoted to this aspect in the present book clearly demonstrates that the prediction and prevention of acid mine drainage are key elements of a strategy to control pollution from mining operations.

A major part of mineral reserves are in less-developed countries. A disproportionate fraction of resource development is expected to take place in the areas where environmental protection measures may be limited. Such experience will imply far-going demands from the host countries: (1) Reclamation should be carried out, as far as possible, during the life of the mine; (2) technology to ameliorate long-term effects should be as self-supporting as possible; (3) simple, reliable, low-energy techniques for minimizing deleterious effects of mining should be developed. The latter requirement can be summarized in the short expression "working with and not against nature". Initial efforts will be described in this book.

With 30 contributions, the two-volume book is mainly addressed to two major groups of potential users: to environmental chemists, biologists and geochemists working for mining companies, consultant agencies and universities, and to managers and planners in both industry and governmental agencies.

Chemistry and Biology of Dredged Materials and Mine Tailings, is introduced by review articles on three scientific disciplines, which seem to be particularly relevant for the present subject: solution/solid interactions of metal (A. Bourg), microbial processes (O. H. Tuovinen) and behavior of vegetation (W. H. O. Ernst). These reviews are followed by in-depth contributions on biological and chemical characteristics of the two types of solid wastes. They include case histories as well as laboratory (experimental) assessment of actual or potential environmental impact of both organic and inorganic priority pollutants.

Environmental Management of Dredged Materials and Mine Tailings will certainly fulfill expectations of a wide spectrum of practitioners, in that latest results are presented from management plans and decision-making processes in both

fields. Examples are given from new mining operations in both developed and developing countries (I. Ritchie; R. Higgins), and the most advanced approaches to dredged material handling by the Municipality of Rotterdam and the U.S. Government (H. Nijssen; C.R. Lee and R.K. Peddicord). With respect to the future development in these areas, the reader should particularly refer to the articles on "ecological engineering" (K. Kalin and R.O. van Everdingen), "biological engineering" (D.V. Ellis and L. Taylor), use of "integrated biological systems" (H. von Michaelis). Several other contributions describing methods of "geochemical engineering" emphasize the increasing efforts of using natural resources available at the disposal site for reducing negative environmental effects of all types of solid waste materials.

Last but not least we would like to express our gratitude to all contributors for their enthusiastic and cooperative response to this project. We are very thankful to Dr. Engel, Springer-Verlag, for his constant encouragement, and for the much appreciated assistance of the publisher in the preparation of these volumes.

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Contents