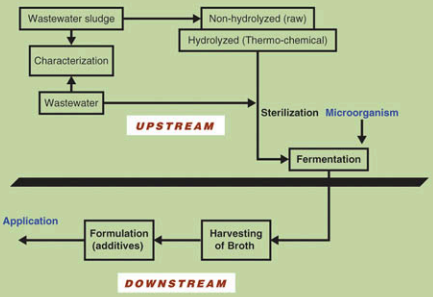
Sustainable Sludge Management

Production of Value Added Products



EDITED BY

R. D. Tyagi, Rao Y. Surampalli, Song Yan, Tian C. Zhang, C. M. Kao, and B. N. Lohani

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SUSTAINABLE SLUDGE MANAGEMENT

PRODUCTION OF VALUE ADDED PRODUCTS

SPONSORED BY
Sustainable Sludge Management Task Committee
of the Environmental Council

Environmental and Water Resources Institute (EWRI)
of the American Society of Civil Engineers

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Preface

The 21st century indicates an increasing interest in sustainable sludge management- production of value added products. These products have attracted the attention of citizens, scientists, engineers, researchers, state/federal agencies, environmental groups, industrial/commodity groups and regulators.

Stricter regulations imposed on sustainable sludge management in different countries is catalyzing the re-orientation of the sludges to value-addition. Processes which promote sustainability will become viable options for resource management if conversion into a "value-added product" can be realized. A value-added product implies that the value of the final product should exceed the cost of processing.

The ASCE's Technical Committee on Hazardous, Toxic, and Radioactive Waste Management identified the need to collect and present the latest information on the recent trends in bioconversion of sludge to value added products namely, biopesticides, biosurfactants, enzymes, bioplastics, biofertilizers/biofloculants. The committee envisioned preparing an easy-to-read book that would serve as a reference for practicing professionals and be equally effective as a text in undergraduate or graduate courses.

This book report is organized by types of value added products by sludge (biosolids). Chapter 1 introduces the topic of the book report. Chapter 2 discusses wastewater sludge characteristics. Chapter 3 discusses value added products from wastewater sludge: a road to sustainability, while Chapter 4 talks about emerging value added products and miscellaneous products. Chapters 5, 6, 7, 8, 9 and 10 present detailed information about bioconversion of sludge to various types of value added products-biosurfactant, bioplastics, bioflocculants, biopesticides, biofertilizers/ bioinoculants, enzymes, respectively. Finally, Chapter 12 discusses the fate of priority and emerging organic compounds during pre-treatment and bioconversion of wastewater sludge.

The editors acknowledge the hard work and patience of all authors who have contributed to this book.

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CHAPTER 1

Introduction

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1.1 Background

The increase in urban population world over with concomitant growth in wastewater treatment plants has caused production of large volumes of wastewater sludge. Sewage sludge is generated mainly by primary (physical and/or chemical), secondary (biological) and tertiary (additional to secondary, often nutrient removal) wastewater treatment. It accounts for the largest volume of solid waste generated by municipal wastewater treatment plants. Municipal sewage sludge processing, utilization and disposal are of the most difficult and expensive operations conducted by municipalities today. In the United States, it is estimated that 7.1 million tons of biosolids was generated for use or disposal in 2000, growing to 7.6 million tons in 2005 and to 8.2 million tons in 2010. This sludge must be managed in an environmentally acceptable way.

Sludge is over 95% water and must generally undergo various treatment processes such as preliminary operations (e.g., storage, grinding, blanding degritting), thickening, stabilization, conditioning, dewatering, among others (e.g., heat drying/other processing, thermal reduction), before its reuse or final disposal. The water content is generally reduced by thickening and dewatering. Sludge thickening is achieved through the use of drum thickeners and gravity belt thickeners. Sludge also goes through a biological stabilization process to reduce the fermentation potential of the organic matter and to reduce the concentration of pathogenic microorganisms. Stabilization can be achieved through microbial (anaerobic or aerobic) digestion or thermal stabilization. Dewatering is done by means of centrifugation, filtration, or thermal drying. Dewatered, stabilized sludge is generally in the form of a “cake” that still contains some water. Sludge cakes can be landfilled, incinerated, or used as a soil amendment. The combustion of sludges produces fly ash (small airborne particles that can penetrate deep into the respiratory