

Contents

Foreword	v
Preface	ix
Contributors	xv
Part I Overview of Antifouling Biocides	
1 Release Rate of Biocides from Antifouling Paints.....	3
Kazunobu Takahashi	
2 International Trends in Regulatory Aspects.....	23
Tetsuya Senda	
Part II Behavior of Organotin Compounds and Their Effects on Aquatic Organisms	
Section 1 Distribution of Organotin Compounds in Aquatic Environments	
3 Global Contamination by Organotin Compounds	39
Kurunthachalam Kannan and Shinsuke Tanabe	
4 Contamination by Organotin Compounds in Asia	61
Takaomi Arai and Hiroya Harino	
5 Behaviour of Organotins in the Coastal Environment	75
William John Langston, Hiroya Harino, and Nicholas Dingle Pope	
6 Organotin Contamination in Deep Sea Environments	95
Hiroya Harino, Takaomi Arai, Madoka Ohji, and Nobuyuki Miyazaki	

Section 2 Organotin Compounds as Endocrine Disruptors

- 7 Mechanism of Imposex Induced by Organotins in Gastropods 111
Toshihiro Horiguchi
- 8 The Endocrine-Disrupting Effect of Organotin Compounds
for Aquatic Organisms 125
Toshihiro Horiguchi

Section 3 Toxicity of Organotin Compounds in Aquatic Organisms

- 9 Toxicity for Aquatic Organisms 149
Kazuhiko Mochida and Kazunori Fujii
- 10 Biological Effects of Tributyltin on the Caprellidea
(Crustacea: Amphipoda) 161
Madoka Ohji
- 11 Toxic Interactions Between Tributyltin and Polychlorinated
Biphenyls in Aquatic Organisms 195
Yuji Oshima, Kei Nakayama, Takeshi Hano, Sang Gyoong Kim,
Yohei Shimasaki, Ik Joon Kang, and Tsuneo Honjo
- 12 Immunotoxic Effects of Organotin Compounds
in Teleost Fish 207
Ayako Nakayama, Helmut Segner, and Shin'ichiro Kawai

**Section 4 Genetic and Physiological Impacts
of Organotin Compounds**

- 13 Genetic Impacts of Organotin Compounds 221
Tsuyoshi Nakanishi and Jun-ichi Nishikawa
- 14 Effects of Organotins on the Drug Metabolizing
Enzymes in Fish 235
Shin'ichiro Kawai and Ayako Nakayama

**Section 5 Bioaccumulation of Organotin Compounds
in Aquatic Organisms**

- 15 Plankton 253
Inneke F. M. Rumengen and Madoka Ohji
- 16 Molluscs 271
William John Langston and Nicholas Dingle Pope

Contents	xiii
----------	------

17 Fish	291
Takaomi Arai	

Part III Environmental Chemistry of Alternative Biocides

Section 6 Analytical Methods

18 The Analysis of Antifouling Paint Biocides in Water, Sediment and Biota	311
Kevin V. Thomas and Katherine H. Langford	

Section 7 Monitoring of Alternative Biocides

19 Europe and USA	331
Kevin V. Thomas and Katherine H. Langford	

20 Asia	345
Hiroya Harino, Takaomi Arai, Madoka Ohji, and Nobuyuki Miyazaki	

Section 8 Toxicity in Aquatic Organisms

21 Toxicity in Plankton and Fish	365
Kazuhiko Mochida and Kazunori Fujii	

22 Further Effects of Alternative Biocides on Aquatic Organisms	383
Kazuhiko Mochida and Kazunori Fujii	

Section 9 Characteristics of Alternative Biocides in Aquatic Environments

23 Degradation of Alternative Biocides in the Aquatic Environment.....	397
Hiroya Harino and William John Langston	

24 Copper Biocides in the Marine Environment.....	413
Steven J. Brooks and Mike Waldock	

Part IV General Summary

25 Overview	431
Hiroya Harino	

Index.....	433
-------------------	-----