

**Design Manual for
Waste Stabilization Ponds
in India**



**Design
Manual for
WASTE
STABILIZATION
PONDS
in
India**

Duncan Mara

*Professor of Civil Engineering
University of Leeds
and Chairman
Lagoon Technology International
Leeds, England*

First published in 1997 by Lagoon Technology International Ltd.,
Newton House, Newton Road, Leeds LS7 4DN, England.

©Lagoon Technology International Ltd., 1997

All rights reserved.

No part of this publication may be reproduced, stored in any retrieval system, or transmitted, by any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission of the copyright owner.

ISBN 0 9519869 1 0

British Library Cataloguing-in-Publication Data. A catalogue record for this book is available from the British Library.

Printed by University Print Services
A division of Media Services at Leeds

DISCLAIMER

The Department for International Development and the Government of India bear no responsibility for, and are not in any way committed to, the views and recommendations contained in this Manual.

Contents

Preface	ix
1. Introduction	1
1.1 The need for wastewater treatment	1
1.2 Advantages of waste stabilization ponds	1
1.3 About this Manual	8
2. WSP applicability and usage in India	9
2.1 Applicability	9
2.1.1 Anaerobic ponds	10
2.2 Usage	11
2.2.1 Titagarh	12
2.2.2 Ballay and North Howrah	13
2.2.3 Calcutta East Wastewater-fed fishponds	14
3. Wastewater treatment in WSP	17
3.1 Types of WSP and their function	17
3.1.1 Anaerobic ponds	18
3.1.2 Facultative ponds	19
3.1.3 Maturation ponds	21
3.2 BOD removal	21
3.3 Pathogen removal	25
3.3.1 Bacteria	25
3.3.2 Viruses	26
3.3.3 Parasites	26
3.4 Nutrient removal	27
3.4.1 Nitrogen	27
3.4.2 Phosphorus	27
3.5 Environmental impact of WSP systems	28
4. Process design of WSP	29
4.1 Effluent quality requirements	29
4.2 Design parameters	31
4.2.1 Temperature and evaporation	31
4.2.2 Flow	31
4.2.3 BOD	32
4.2.4 Nitrogen	32
4.2.5 Faecal coliforms	32
4.2.6 Helminth eggs	33
4.3 Anaerobic ponds	33

4.4	Facultative ponds	36
4.4.1	Latitude	36
4.4.2	Temperature	37
4.4.3	BOD removal	40
4.5	Maturation ponds	40
4.5.1	Faecal coliform removal	40
4.5.2	Helminth egg removal	43
4.5.3	BOD removal	44
4.5.4	Nutrient removal	45
4.6	Initial partial treatment	46
4.6.1	Anaerobic ponds	46
4.6.2	Facultative ponds	47
5.	Physical design of WSP	49
5.1	Pond location	49
5.2	Geotechnical considerations	50
5.3	Hydraulic balance	51
5.4	Preliminary treatment	54
5.5	Pond geometry	55
5.6	Inlet and outlet structures	57
5.7	By-pass pipework	59
5.8	Recirculation	59
5.9	Teebelt	60
5.10	Security	60
5.11	Operator facilities	61
6.	Operation and maintenance	63
6.1	Start-up procedures	63
6.2	Routine maintenance	65
6.3	Staffing levels	66
6.4	Desludging and sludge disposal	66
7.	Monitoring and evaluation	69
7.1	Effluent quality monitoring	69
7.2	Evaluation of pond performance	71
7.3	Data storage and analysis	75
8.	Rehabilitation and upgrading	77
8.1	Rehabilitation	77
8.2	Upgrading and extending existing WSP	78
8.3	Algal removal	78
9.	Wastewater treatment and storage reservoirs	81
9.1	Single-WSTR system	81
9.2	Hybrid WSP-WSTR system	82
10.	Effluent reuse	85
10.1	Microbiological quality guidelines	85
10.2	Physicochemical quality guidelines	88

10.3	Agricultural reuse	90
10.4	Aquacultural reuse	90
10.4.1	Traditional practice	90
10.4.2	Improved fishpond design	91
	References	95
	<i>Annex I</i> WSP Process Design Examples	103
	1. Surface water discharge	103
	2. Restricted irrigation	105
	3. Unrestricted irrigation	107
	4. Fish culture	108
	5. Wastewater storage & treatment reservoirs	110
	<i>Annex II</i> Analytical Techniques	113
	1. Chlorophyll <i>a</i>	113
	2. Algal identification	114
	3. Sulphide	118
	<i>Annex III</i> Environmental Impact of WSP Systems	121

Preface

Waste stabilization ponds are an extremely appropriate method of wastewater treatment in India, and I hope that this Manual will serve to promote modern pond design in the country. Of course design by itself is not enough: operation and maintenance are crucial, but fortunately with ponds this is simple and does not require skilled labour. Guidance is also given on pond monitoring and evaluation, and this can lead to improved design – there is no substitute for local data. Sometimes, because of more rigorous legislation or neglect, pond systems need upgrading or rehabilitation, and this is also discussed.

In many developing countries, and India is no exception, wastewater is generally too valuable to waste, and the reuse of pond effluents for crop irrigation or for fish culture is very important in the provision of high quality food. In arid zones, the use of wastewater storage and treatment reservoirs is advantageous as it permits the whole year's wastewater to be used for irrigation, thus enabling the irrigation of a much larger area and the consequent production of much more food.

This manual has been wholly financed by the Department for International Development of the United Kingdom Government as part of its bilateral aid programme with the Government of India. During its preparation many people in India have provided help. I am especially grateful to Mr R P Sharma of the National River Conservation Directorate; Mr Ian Curtis of the DFID Water and Sanitation Office in New Delhi; Dr Dhrubajyoti Ghosh of the Calcutta Metropolitan Water and Sanitation Authority; Dr S N Kaul of the National Environmental Engineering Research Institute, Nagpur; and Mrs Shanta Sheela Nair and her staff at MetroWater, Chennai.

Duncan Mara
Leeds, England
September 1997

