

**THE ECONOMIC AND
ENVIRONMENTAL IMPACT
OF PHOSPHORUS
REMOVAL FROM
WASTEWATER IN THE
EUROPEAN COMMUNITY**

G K Morse, J N Lester and R Perry



1993

12665

Contents

	Page
1. <i>Introduction</i>	1
1.1 Background	1
1.2 Study objectives	1
1.3 Study methodology	1
1.4 Study scope	2
1.5 Report structure	2
2. <i>Eutrophication and phosphorus management in the European Community</i>	3
2.1 Introduction and overview	3
2.2 Eutrophication and phosphorus management	3
2.2.1 <i>Eutrophication and phosphorus</i>	3
2.2.2 <i>Phosphorus sources and inputs to surface waters</i>	5
2.2.3 <i>Phosphorus control options and strategies</i>	6
2.3 Eutrophication in the European Community	8
2.4 Phosphorus sources in the European Community	9
2.5 Phosphorus management strategies in the European Community	11
2.6 Summary and conclusions	13
3. <i>Wastewater treatment and sludge management in the European Community</i>	15
3.1 Introduction and overview	15
3.2 Wastewater collection and treatment	15
3.3 Sludge treatment	21
3.4 Sludge disposal	23
3.5 Wastewater treatment and sludge management in Western Europe	25
3.6 Summary and conclusions	30
4. <i>The impact of phosphorus removal from wastewater</i>	31
4.1 Introduction and overview	31
4.2 Phosphorus removal methods	31
4.2.1 <i>Chemical precipitation</i>	31
4.2.2 <i>Biological phosphorus removal</i>	33

4.3	General impact assessment	34
	4.3.1 <i>Introduction and overview</i>	34
	4.3.2 <i>Impact of chemical addition</i>	36
	4.3.3 <i>Impact on wastewater treatment</i>	39
	4.3.4 <i>Impact on sludge production</i>	41
	4.3.5 <i>Impact on sludge treatment</i>	43
	4.3.6 <i>Impact on sludge disposal</i>	45
	4.3.7 <i>Impact on receiving waters</i>	47
	4.3.8 <i>Impact of chemical provision</i>	47
	4.3.9 <i>Impact of energy production</i>	48
4.4	General impact summary	48
4.5	Sensitivity and risk analysis	52
4.6	Key European Community scenarios	56
	4.6.1 <i>Introduction and overview</i>	56
	4.6.2 <i>Short term scenario: Removal in sensitive areas</i>	56
	4.6.3 <i>Long term scenario: Complete phosphorus removal</i>	59
	4.6.4 <i>The impact of detergent phosphorus</i>	61
4.7	Summary and conclusions	63
5.	<i>The impact of alternative detergent builders</i>	65
5.1	Introduction and overview	65
5.2	Consumer use and toxicity	65
5.3	Raw materials and production	67
5.4	Wastewater treatment and receiving waters	68
5.5	Sludge management	69
5.6	Summary and conclusions	70
6.	<i>Study conclusions</i>	71
	<i>References</i>	75
	<i>Annex a: Basic country information</i>	91