
Water Technology Markets 2010

Foreword	ii
-----------------	-----------

Executive summary	iii
--------------------------	------------

1. Introduction: The challenge of water technology	1
---	----------

1.1 What is the water technology market?	1
Figure 1.1 Global water market overview	2
1.2 Market forecasts	3
Figure 1.2 Global water market forecast to 2016	3
Figure 1.3 Compound annual growth rate of water market sectors 2007- 2016	4
Figure 1.4 Global water market forecast by region to 2016	5
1.3 Municipal procurement	5
1.3.1 Municipal procurement in America	5
1.3.2 Municipal procurement in the rest of the world	6
1.4 Industrial market procurement	6
1.5 The challenge for new technology	7
1.6 Fragmentation	7
1.7 Market structure	8
1.8 Consolidation in water technology	9
1.9 Cracking the market	9
Figure 1.5 Overcoming the obstacles to new technologies in the desalination sector	10
1.10 Investing in water technology	10

2. Drivers	12
-------------------	-----------

2.1 Energy	12
-------------------	-----------

Figure 2.1 Energy Requirements for Water Treatment, Water Distribution and Wastewater Management	12
2.1.1 Rising energy costs will increase the cost of water services	12
2.1.2 Urbanisation and water scarcity will make water service provision more energy intensive	13
2.1.3 Reducing greenhouse gas emissions will promote energy efficiency and recovery	13
2.1.4 There is potential for net energy generation from wastewater treatment	13
Figure 2.2 Electricity requirements for activated sludge wastewater	13
2.1.5 There are significant opportunities for improvements in distribution system energy efficiency	14

2.2 Water Scarcity	14
---------------------------	-----------

2.2.1 The basics	14
Figure 2.3 The dynamics of water demand 1900 - 2025	14
Figure 2.4 Worldwide water availability 2025	15
Figure 2.5 Worldwide water availability by region 2025	15
2.2.2 Climate Change will have negative effects on water availability	15
2.2.3 Non-renewable Groundwater Resources are being depleted	16

2.3 Sludge Disposal	16
----------------------------	-----------

2.3.1 Large quantities of sludge have to be disposed of annually	16
2.3.2 Sludge Treatment and Disposal Costs represent a significant portion of overall treatment costs	17
2.3.3 Tighter regulatory limits will increase treatment costs and pressurises existing disposal routes	17
2.3.4 Waste sludge represents a potential source of energy	17
2.3.5 Sewage sludge represents a source for resource recovery	18
2.4 Nutrient Removal	18
2.4.1 Nutrient limits are at the forefront of new discharge limits for wastewater treatment plants	18
2.4.2 Nutrient Trading may provide additional financial incentives to reduce nutrient discharges	19
2.4.3 Interest in resource recovery will promote wastewater nutrient recovery technologies	19
2.5 The infrastructure gap	19
2.6 Ageing infrastructure	20
Figure 2.6 The age of U.S. water and wastewater pipe	20
Figure 2.7 Non-revenue water: top 20 losers	20
2.7 Emerging contaminants	21
2.7.1 Emerging Contaminants in Wastewater Treatment Plants	21
2.7.2 Potential regulatory Limits for emerging contaminants	22
2.7.3 Concerns regarding long term impact of emerging contaminants on the Environment	22
2.7.4 Human health concerns	23
2.7.4.1 Microbial resistance to antibiotics	23
2.7.4.2 Endocrine disrupting effects	23
2.8 Drivers - Summary	23
Figure 2.8 Summary of drivers	23
3. Wastewater treatment	25
3.1 Introduction	25
3.1.1 Overview	25
3.1.2 Market forecast	25
Figure 3.1 Wastewater treatment plant market forecast	26
Figure 3.2 Sludge management market forecast	27
3.2 Energy Management	28
3.2.1 Energy from wastewater	28
3.2.1.1 Concept	28
3.2.1.2 Development Stage	28
3.2.1.3 What problem does the technology aim to solve	28
3.2.1.4 How does the technology solve the problem?	28
3.2.1.5 Advantages	28
3.2.1.6 Issues	28
3.2.2 Anaerobic Membrane Bioreactor	29
3.2.2.1 Concept	29

3.2.2.2 Development Stage	29
3.2.2.3 What problem does the technology aim to solve?	29
3.2.2.4 How does the technology solve the problem?	29
3.2.2.5 Advantages	29
3.2.2.6 Issues	30
3.2.2.7 Current Status	30
3.2.2.8 Potential/Verdict	31
3.2.2.9 Companies offering anaerobic membrane bioreactors	31
3.2.3 Microbial Fuel Cells	31
3.2.3.1 Concept	31
3.2.3.2 Development Stage	31
3.2.3.3 What problem does the technology aim to solve?	31
3.2.3.4 How does the technology solve the problem?	31
3.2.3.5 Advantages	32
3.2.3.6 Issues	32
3.2.3.7 Current Status	32
3.2.3.8 Potential/Verdict	32
3.2.3.9 Examples of Companies offering microbial fuel cells	33
3.3 Energy efficient primary treatment	33
3.3.1 Chemically Enhanced Primary Treatment	33
3.3.1.1 Concept	33
3.3.1.2 Development Stage	33
3.3.1.3 What problem does the technology aim to solve?	33
3.3.1.4 How does the technology solve the problem?	33
3.3.1.5 Advantages	33
3.3.1.6 Current Status	34
Figure 3.3 DensaDeg™ Treatment Process	34
Figure 3.4 Process diagram for the Actiflo™ process	35
3.3.1.7 Issues	35
3.3.1.8 Potential/Verdict	36
3.3.1.9 Companies offering chemically enhanced primary treatment	36
3.3.2 Energy Efficient Aeration	36
3.3.2.1 Concept	36
3.3.2.2 Development Stage	36
3.3.2.3 What problem does the technology aim to solve?	36
3.3.2.4 How does the technology solve the problem?	36
Figure 3.5 Vertreat™ Process Flow Diagram	37
3.3.2.5 Advantages	37
3.3.2.6 Issues	37
3.3.2.7 Current Status	37
3.3.2.8 Potential/Verdict	38

3.3.2.9 Companies offering energy efficient aeration	38
3.4 Using waste heat	38
3.4.1 Waste heat recovery	38
3.4.1.1 Concept	38
3.4.1.2 Development Stage	38
3.4.1.3 What problem does the technology aim to solve?	38
3.4.1.4 How does the technology solve the problem?	38
3.4.1.5 Advantages	39
3.4.1.6 Issues	39
3.4.1.7 Current Status	39
3.4.1.8 Potential/Verdict	39
3.4.1.9 Examples of Companies offering waste heat recovery technology	40
3.4.2 Waste Heat to Electricity – Organic Rankine Cycle	40
3.4.2.1 Concept	40
3.4.2.2 Development Stage	40
3.4.2.3 What problem does the technology aim to solve?	40
3.4.2.4 How does the technology solve the problem?	40
Figure 3.6 Organic Rankine Cycle Process Diagram	41
3.4.2.5 Advantages	41
3.4.2.6 Issues	41
3.4.2.7 Current Status	41
3.4.2.8 Potential/Verdict	41
3.4.2.9 Examples of companies offering the organic rankine cycle	42
3.5 Biogas to energy	42
3.5.1 Introduction	42
3.5.2 Stirling engines	42
3.5.2.1 Concept	42
3.5.2.2 Development Stage	42
3.5.2.3 What problem does the technology aim to solve	42
3.5.2.4 How does the technology solve the problem?	43
3.5.2.5 Advantages	43
3.5.2.6 Issues	43
3.5.2.7 Current Status	43
3.5.2.8 Potential/Verdict	43
3.5.2.9 Companies offering Stirling engines suitable for WWTPs	44
3.5.3 Fuel Cells	44
3.5.3.1 Concept	44
3.5.3.2 Development Stage	44
3.5.3.3 What problem does the technology aim to solve?	44
3.5.3.4 How does the technology solve the problem?	44
3.5.3.5 Advantages	44
3.5.3.6 Issues	45

3.5.3.7 Current Status	45
3.5.3.8 Potential/Verdict	46
3.5.3.9 Examples of vompanies offering fuel cells	46
3.5.4 Microturbines	46
3.5.4.1 Concept	46
3.5.4.2 Development Stage	46
3.5.4.3 What problem does the technology aim to solve?	46
3.5.4.4 How does the technology solve the problem?	46
3.5.4.5 Advantages	46
3.5.4.6 Issues	46
3.5.4.7 Current Status	47
3.5.4.8 Potential/Verdict	47
3.5.4.9 Companies offering microturbines	47
3.5.5 Biogas treatment for siloxane removal	47
3.5.5.1 Concept	47
3.5.5.2 Development Stage	47
3.5.5.3 What problem does the technology aim to solve	47
3.5.5.4 How does the technology solve the problem?	47
3.5.5.5 Advantages	48
3.5.5.6 Issues	48
3.5.5.7 Current Status	48
3.5.5.8 Companies offering activated carbon technology specifically for siloxane removal	48
3.6 Making sludge / wastewater useful	49
3.6.1 Sludge to oil - pyrolysis	49
3.6.1.1 Concept	49
3.6.1.2 Development Stage	49
3.6.1.3 What problem does the technology aim to solve?	49
3.6.1.4 How does the technology solve the problem?	49
3.6.1.5 Advantages	49
3.6.1.6 Issues	49
3.6.1.7 Current Status	49
3.6.2 Sludge to solid fuels	50
3.6.2.1 Concept	50
3.6.2.2 Development Stage	50
3.6.2.3 What problem does the technology aim to solve?	50
3.6.2.4 How does the technology solve the problem?	50
Figure 3.7 Flow digram of the SlurryCarb™ Process.	51
3.6.2.5 Advantages	51
3.6.2.6 Issues	51
3.6.2.7 Current Status	52
3.6.2.8 Potential/Verdict	52
3.6.2.9 Companies offering sludge to solid fuels	52
3.6.3 Bioplastics from wastewater	52

3.6.3.1 Concept	52
3.6.3.2 Development stage	52
3.6.3.3 What problem does the technology aim to solve	52
3.6.3.4 How does the technology solve the problem	52
3.6.3.5 Advantages	53
3.6.3.6 Issues	53
3.6.3.7 Current Status	54
3.6.3.8 Potential/Verdict	54
3.7 Sludge Treatment and Disposal	55
3.7.1 Sludge pretreatment	55
3.7.1.1 Concept	55
3.7.1.2 Development Stage	55
3.7.1.3 What problem does the technology aim to solve?	55
3.7.1.4 How does the technology solve the problem?	55
Figure 3.8 Sludge pretreatment technologies	56
3.7.1.5 Advantages of the Technology	56
3.7.1.6 Issues	56
3.7.1.7 Current Status	56
3.7.1.8 Potential/Verdict	57
3.7.2 Thermal pretreatment	57
3.7.2.1 Concept	57
3.7.2.2 Development Stage	57
3.7.2.3 How does the technology work?	57
3.7.2.4 Advantages	58
3.7.2.5 Issues	58
3.7.2.6 Current Status	58
3.7.2.7 Potential/Verdict	59
3.7.3 Electroporation pretreatment	59
3.7.3.1 Concept	59
3.7.3.2 Development Stage	59
3.7.3.3 How does the technology work?	59
Figure 3.9 Basic bacterial cell structure	60
3.7.3.4 Advantages	60
3.7.3.5 Issues	60
3.7.3.6 Current Status	60
3.7.3.7 Potential/Verdict	61
3.7.3.8 Companies offering electroportion pretreatment	61
3.7.4 Pulse power electrical arc discharge pretreatment	61
3.7.4.1 Concept	61
3.7.4.2 Development Stage	61
3.7.4.3 How does the technology work?	61
3.7.4.4 Advantages	61
3.7.4.5 Issues	61

3.7.4.6 Current Status	61
3.7.4.7 Potential/Verdict	62
3.7.5 Lysate-thickening centrifuge pretreatment	62
3.7.5.1 Concept	62
3.7.5.2 Development Stage	62
3.7.5.3 How does it work?	62
Figure 3.10 Typical lysate thickening centrifuge	62
3.7.5.4 Advantages	62
3.7.5.5 Issues	62
3.7.5.6 Current Status	63
3.7.5.7 Potential/Verdict	63
3.7.5.8 Companies offering a lysate thickening centrifuge	63
3.7.6 Ultrasonic pretreatment	63
3.7.6.1 Concept	63
3.7.6.2 Development stage	63
3.7.6.3 How does the technology work?	63
3.7.6.4 Advantages	64
3.7.6.5 Issues	64
3.7.6.6 Current status	64
3.7.6.7 Potential/verdict	65
3.7.6.8 Companies offering ultrasonic pretreatment	65
3.7.7 Pressure homogenisation pretreatment	66
3.7.7.1 Concept	66
3.7.7.2 How does the technology work?	66
3.7.7.3 Advantages	66
3.7.7.4 Issues	66
3.7.7.5 Current Status	66
3.7.7.6 Companies offering pressure homogenisation pretreatment	67
3.7.8 Implementation of two phase anaerobic digestion - Enhanced Enzymic Hydrolysis	67
3.7.8.1 Concept	67
3.7.8.2 Development stage	67
3.7.8.3 What problem does the technology aim to solve?	67
3.7.8.4 How does the technology work?	67
3.7.8.5 Advantages	68
3.7.8.6 Issues	68
3.7.8.7 Current status	68
3.7.8.8 Potential / verdict	68
3.7.8.9 Companies offering this technology	68
3.7.9 Ozonation	68
3.7.9.1 Concept	68
3.7.9.2 Development Stage	68
3.7.9.3 How does it work?	69
3.7.9.4 Advantages	69

3.7.9.5 Current Status	69
3.7.9.6 Issues	69
3.7.9.7 Potential/Verdict	69
3.7.9.8 Companies offering ozonation	69
3.7.10 Electro-osmosis sludge dewatering	69
3.7.10.1 Concept	69
3.7.10.2 What problem does the technology aim to solve?	70
3.7.10.3 How does the technology solve the problem?	70
3.7.10.4 Advantages	70
3.7.10.5 Issues	70
3.7.10.6 Current Status	70
3.7.10.7 Potential/Verdict	71
3.7.10.8 Companies offering electro-osmosis sludge dewatering	71
3.7.11 Solar sludge drying	71
3.7.11.1 Concept	71
3.7.11.2 Development Stage	71
3.7.11.3 What problem does the technology aim to solve?	71
3.7.11.4 How does the technology solve the problem?	71
3.7.11.5 Advantages	72
3.7.11.6 Issues	72
3.7.11.7 Current Status	72
3.7.11.8 Potential/Verdict	72
3.7.11.9 Companies offering solar drying	72
3.7.12 Supercritical Wet Air Oxidation (SCWO)	73
3.7.12.1 Concept	73
3.7.12.2 Development Stage	73
3.7.12.3 What problem does the technology aim to solve?	73
3.7.12.4 How does the technology solve the problem?	73
3.7.12.5 Advantages	73
3.7.12.6 Issues	73
3.7.12.7 Current Status	74
3.7.12.8 Potential/Verdict	74
3.7.12.9 Companies offering SCWO	74
3.8 Nutrient removal / recovery	74
3.8.1 Side-stream Treatment	75
Figure 3.11 Process flow diagram of a WWTP with Side-stream Treatment	75
3.8.2 SHARON / ANAMMOX Nitrogen Removal	76
3.8.2.1 Concept	76
3.8.2.2 Development Stage	76
3.8.2.3 What problem does the technology aim to solve?	76
3.8.2.4 How does the technology solve the problem?	76
Figure 3.12 SHARON and ANAMMOX reactors	77
3.8.2.5 Advantages	77

3.8.2.6 Issues	77
3.8.2.7 Current Status	77
3.8.2.8 Potential/Verdict	78
3.8.2.9 Companies offering SHARON/ANAMMOX	78
3.8.3 DEamMONification (DEMON)	78
3.8.3.1 Concept	78
3.8.3.2 Development Stage	78
3.8.3.3 What problem does the technology aim to solve?	78
3.8.3.4 How does the technology solve the problem?	78
3.8.3.5 Advantages	79
3.8.3.6 Issues	79
3.8.3.7 Current Status	79
3.8.3.8 Potential/Verdict	79
3.8.3.9 Companies offering DEMON	79
3.8.4 Ammonia Recovery Process (ARP)	79
3.8.4.1 Concept	79
3.8.4.2 Development Stage	79
3.8.4.3 What problem does the technology aim to solve	80
3.8.4.4 How does the technology solve the problem?	80
3.8.4.5 Advantages	80
3.8.4.6 Issues	80
3.8.4.7 Current Status	80
3.8.4.8 Potential/Verdict	80
3.8.4.9 Companies offering the Ammonia Recovery Process	80
3.8.5 Phosphorus Recovery as Struvite	81
3.8.5.1 Concept	81
3.8.5.2 Development Stage	81
3.8.5.3 What problem does the technology aim to solve?	81
3.8.5.4 How does the technology solve the problem?	81
Figure 3.13 Struvite precipitation process diagram	81
3.8.5.5 Advantages	81
3.8.5.6 Issues	82
3.8.5.7 Current Status	82
3.8.5.8 Potential/Verdict	82
3.8.5.9 Companies offering phosphorus recovery as struvite	83
3.8.6 Phosphorus Recovery from Sewage Sludge	83
3.8.6.1 Concept	83
3.8.6.2 Development Stage	83
3.8.6.3 What problem does the technology aim to solve?	83
3.8.6.4 How does it solve it?	83
3.8.6.5 Advantages	84
3.8.6.6 Issues	84
3.8.6.7 Current Status	84
3.8.6.8 Potential/Verdict	84

3.8.6.9 Companies offering phosphorus recovery from sewage sludge	85
3.8.7 Phosphorus Recovery directly from Wastewater	85
3.8.7.1 Concept	85
3.8.7.2 Development Stage	85
3.8.7.3 What problem does the technology aim to solve?	85
3.8.7.4 How does the technology solve the problem?	85
3.8.7.5 Advantages	86
3.8.7.6 Issues	86
3.8.7.7 Current Status	86
3.8.7.8 Potential/Verdict	86
3.8.7.9 Companies offering phosphorus recovery directly from wastewater	87
3.9 Co-digestion	87
3.9.1 Concept	87
3.9.2 Development Stage	87
3.9.3 What problem does the technology aim to solve?	87
3.9.4 How does the technology solve the problem?	87
3.9.5 Advantages	87
3.9.6 Issues	87
3.9.7 Current status	88
3.9.8 Potential/Verdict	88
3.9.9 Companies offering co-digestion	88
4. Membrane treatment and desalination	89
4.1 Introduction	89
4.1.1 Current technology status	89
4.1.1.1 Thermal desalination: MSF	89
Figure 4.1 Multi-Stage Flash desalination	89
4.1.1.2 Thermal desalination: MED	90
Figure 4.2 The Multi-Effect Distillation desalination process	90
Figure 4.3 The top ten MED plants by capacity in the world (by contract date)	90
4.1.1.3 Membrane desalination: Reverse osmosis	91
Figure 4.4 The Reverse Osmosis desalination process	91
Figure 4.5 Best hope for reducing desalination cost survey, 2009	92
4.1.1.4 Membrane desalination: Electrodialysis	92
Figure 4.6 The electrodialysis desalination process	92
4.1.2 Desalination process trends	93
Figure 4.7 Global contracted desalination capacity by technology	93
4.1.3 Desalination cost comparisons	93
Figure 4.8 Relative operating costs of the main desalination processes	94
Figure 4.9 Actual desalinated water prices	94
Figure 4.10 Capital cost of recent SWRO desalination plants	95
Figure 4.11 Segmental RO capital costs	95
Figure 4.12 Segmental MED capital costs	96

Figure 4.13 Segmental MSF capital costs	96
4.1.4 The desalination market-place	96
4.1.4.1 Desalination subsystems: pretreatment	97
Figure 4.14 UF pretreatment market	97
Figure 4.15 UF/MF membranes in pretreatment for SWRO sales forecast 2007-2016	98
4.1.4.2 Desalination subsystems: reverse osmosis membranes	98
Figure 4.16 RO flux rates, 1978-2006	98
Figure 4.17 RO membrane market forecast	99
4.1.4.3 Desalination subsystems: energy recovery	100
Figure 4.18 Energy recovery devices: market share by supplier	100
4.1.5 The desalination market	100
Figure 4.19 Annual cumulative desalination capacity: contracted and installed	101
Figure 4.20 Annual additional desalination capacity: contracted and installed	102
Figure 4.21 Desalination market forecast to 2016: annual contracted capacity	102
Figure 4.22 Capital expenditure on desalination plants forecast (2009 -2016)	103
Figure 4.23 Top 20 desalination markets by new contracted capacity (forecast)	103
Figure 4.24 Top 20 desalination markets by capital expenditure (forecast)	104
4.1.6 New desalination technologies	104
4.1.7 Renewable energy in desalination	105
4.1.8 Low-pressure membranes	106
4.1.8.1 The main membrane processes	106
Figure 4.25 Membrane characteristics	106
4.1.8.2 The low-pressure membrane market	107
Figure 4.26 Low-pressure membrane market forecast	108
Figure 4.27 Membrane bioreactor (MBR) market forecast	109
Figure 4.28 UF/MF membrane market forecast for drinking water applications	109
Figure 4.29 UF/MF membrane market forecast for tertiary wastewater applications	109
Figure 4.30 UF/MF membrane market forecast for tertiary wastewater applications	110
Figure 4.31 UF/MF membrane market forecast for desalination pretreatment applications	110
4.2 New membrane technologies	110
4.2.1 Nano-engineered membranes	110
4.2.2 Concept	110
4.2.3 Thin film nanocomposite membranes	110
4.2.4 Aquaporin	111
Figure 4.32 Passage of water molecules through aquaporin	112
4.2.5 Carbon Nanotubes	113
4.3 Membrane distillation	114
4.3.1 Concept	114
4.3.2 Development Stage	114
4.3.3 What problem does the technology aim to solve?	114
4.3.4 How does the technology solve the problem	114
Figure 4.33 Four common configurations of membrane distillation	115

4.3.4.1 The Dutyion™ Root Hydration System (dRHSTM)	115
4.3.4.2 Memstill®	115
4.3.5 Advantages	116
4.3.5.1 The Dutyion™ Root Hydration System (dRHSTM)	116
4.3.5.2 Memstill®	116
4.3.6 Issues	116
4.3.7 Current Status	117
4.3.7.1 The Dutyion™ Root Hydration System (dRHS™)	117
4.3.7.2 Memstill®	117
4.3.7.3 Joint project between UNESCO Centre for Membrane Science & Technology, University of New South Wales and University of Sydney	117
4.3.8 Potential / Verdict	117
4.3.9 Companies Offering this Technology	118
4.4 Forward osmosis	118
4.4.1 Concept	118
4.4.2 How the technology works	118
4.4.3 Advantages	118
4.4.3.1 Fresh water production	118
Figure 4.34 Fresh water production using forward osmosis	119
4.4.3.2 Hybrid Arrangement	119
Figure 4.35 Hybrid FO - RO arrangement	119
4.4.3.3 Power Production	119
Figure 4.36 Power production using pressure retarded osmosis	120
4.4.4 Issues	120
4.4.5 Current status	120
4.4.6 Potential / Verdict	120
4.5 Deep Sea Reverse Osmosis	120
4.5.1 Concept	120
4.5.2 How the technology works	120
Figure 4.37 Deep sea reverse osmosis - system arrangement	121
4.5.3 Advantages	121
4.5.4 Issues	121
4.5.5 Current status	121
4.6 Salt recovery and zero liquid discharge	122
4.6.1 Concept	122
4.6.2 Development stage	122
4.6.3 What problem does the technology aim to solve?	122
4.6.4 How does the technology solve the problem?	122
4.6.5 Advantages	122
4.6.6 Issues	122
4.6.7 Current Status	122
4.6.8 Potential/Verdict	123

5. Disinfection Technologies Market	124
Figure 5.1 Overall disinfection market forecast	125
5.1 Ultraviolet (UV) radiation systems	126
5.1.1 Concept	126
5.1.2 How does the technology solve the problem	126
5.1.2.1 Effect of ultraviolet radiation	126
Figure 5.2 UV light destroys microorganisms by changing the genetic information of DNA	126
5.1.2.2 1UV-C Production	126
Figure 5.3 UV-C in the spectrum of electromagnetic radiation	127
5.1.2.3 Dose and germicidal destruction relationship	127
Figure 5.4 Effect on Escherichia coli (waterborne indicator pathogen) at 5.4 mJ/cm ₂ dose	127
Figure 5.5 Dose requirements for some common microorganisms	127
Figure 5.6 Dose requirements for some common microorganisms	128
5.1.2.4 Parameters influencing the effect of UV treatment	128
5.1.3 Advantages	128
5.1.4 Issues	129
5.1.5 Market analysis	129
5.1.5.1 Western Europe	129
5.1.5.2 North America	129
5.1.5.3 East Asia Pacific and South Asia	129
5.1.6 Major companies offering UV radiation systems	130
Figure 5.7 Overall UV market forecast	131
Figure 5.18 UV systems market forecast	131
5.2 High Reflectivity UV Chambers	132
5.2.1 Concept:	132
5.2.2 Development Stage:	132
5.2.3 What problem does the technology aim to solve	132
5.2.4 How does the technology solve the problem?	132
Figure 5.8 Conventional and high reflectivity UV chambers	132
5.2.5 Advantages	133
5.2.6 Issues	133
5.2.7 Current Status	133
5.2.8 Potential/Verdict	133
5.2.9 Companies offering high reflectivity UV chambers	133
5.3 Ozonation	133
5.3.1 Concept	133
5.3.2 How does the technology solve the problem	133
5.3.2.1 How ozone works in disinfection	133
Figure 5.9 Impact of wastewater constituents on the use of ozone for wastewater disinfection	134
5.3.2.2 Ozone production	134
Figure 5.10 Air discharge (also known as silent or corona discharge)	134
Figure 5.11 A depiction of ozone production by high voltage electricity	135

Figure 5.12 Polymer Electrolyte Membrane (PEM) Cell	135
Figure 5.13 PEM Ozone System	136
5.3.2.3 Ozone disinfection system components	136
5.3.3 Advantages	137
5.3.4 Issues	137
5.3.5 Market analysis	137
5.3.5.1 Western Europe	137
5.3.5.2 North America	137
5.3.5.3 East Asia Pacific and South Asia	137
5.3.5.4 Growth	137
5.3.5.5 New applications and challenges:	138
5.3.5.6 History:	138
5.3.6 Major companies operating in this market	138
Figure 5.14 Ozone systems market forecast	139
5.4 Chlorination	140
5.4.1 Concept	140
5.4.2 How does the technology solve the problem	140
5.4.3 Chlorination chemicals Market	140
5.4.4 Chlorination equipment Market	140
5.4.5 Advantages	141
5.4.6 Issues	141
5.4.7 Market analysis	141
5.4.7.1 Chlorination chemicals market	141
5.4.7.2 Chlorination equipment market	141
5.4.8 Major companies operating in the chlorination chemicals market	141
Figure 5.15 Chlorination market forecast	142
5.5 Advanced Oxidation Technologies	143
5.5.1 Concept	143
5.5.2 Development Stage	143
5.5.3 What problem does the technology aim to solve?	143
5.5.4 How does the technology solve the problem?	143
5.5.5 Advantages	143
5.5.6 Issues	143
5.5.7 Current Status	144
5.5.8 Potential/Verdict	144
5.5.9 Companies offering advanced oxidation technologies	144
Figure 5.16 Advanced oxidation and other market forecast	145
5.6 Ultrasound treatment of wastewater	146
5.6.1 Concept	146
5.6.2 Development stage	146
5.6.3 What problem does the technology aim to solve?	146
5.6.4 How does the technology solve the problem?	146

5.6.5 Advantages	146
5.6.6 Issues	146
5.6.7 Current status	146
5.6.8 Potential / verdict	147
5.7 Bromine Based Disinfection	147
5.7.1 Concept:	147
5.7.2 Development Stage:	147
5.7.3 What problem does the technology aim to solve	147
5.7.4 How does the technology solve the problem	147
5.7.5 Advantages	147
5.7.6 Issues	147
5.7.7 Companies offering bromine based disinfection	148
5.8 Pasteurisation with waste heat	148
5.8.1 Concept	148
5.8.2 Development Stage	148
5.8.3 What problem does the technology aim to solve?	148
5.8.4 How does the technology solve the problem	148
Figure 5.17 Pasteurization Technology Group Process Diagram	148
5.8.5 Advantages	149
5.8.6 Issues	149
5.8.7 Current Status	149
5.8.8 Potential/Verdict	149
5.8.9 Companies offering pasteurisation with waste heat	149
5.9 Water Quality Testing	149
5.9.1 The paradox of water quality testing	149
5.9.2 The water quality testing market	150
5.9.3 Market Analysis	150
5.9.3.1 Laboratories	150
5.9.3.2 Specialty equipment	151
6. Infrastructure	152
6.1 Introduction	152
6.1.1 The infrastructure challenge	152
6.1.2 Forecast	152
Figure 6.1 Infrastructure market forecast	153
6.2 Pumps	154
6.2.1 Concept	154
6.2.2 Submersible pumps	154
6.2.3 Non-submersible pumps	154
6.2.3.1 Dynamic pumps	154
6.2.3.2 Positive Displacement (PD) pumps	154

6.2.4 Market analysis	155
6.2.4.1 Pump market	155
Figure 6.2 Pumps market forecast	157
6.3 Valve Market	158
6.3.1 Market analysis	158
Figure 6.3 Global valves market forecast	159
6.4 Non Revenue Water (Physical Losses):Leak reduction and pipe equipment	160
Figure 6.4 A standard water balance	160
Figure 6.5 Major factors that influence leakage	160
6.4.1 Leak reduction	161
6.4.1.1 Concept	161
6.4.2 What problem does the technology aim to solve	161
6.4.3 How does the technology solve the problem	161
Figure 6.6 The 4-Component Approach towards water loss reduction	161
6.4.3.1 Pressure management	161
6.4.3.2 Active leakage control	162
Figure 6.7 The correlating technique	162
6.4.3.3 Speed and quality of repairs	163
6.4.3.4 District Metered Areas (DMA) – Zone flow analysis	163
6.4.4 Market analysis:	163
6.4.4.1 Non revenue water service market	163
6.4.5 Pipe management – New lay and rehabilitation	164
6.4.5.1 Concept	164
6.4.5.2 What problem does the technology aim to solve	164
6.4.5.3 How does the technology solve the problem	164
6.4.6 Market analysis	167
6.4.6.1 Pipe equipment market (new lay and rehabilitation)	167
6.4.6.2 Pipe materials market	168
Figure 6.8 Technologies used for drinking water pipe repair (market share)	168
Figure 6.9 Technologies used for sewer pipe repair (market share)	168
6.4.6.3 Market dynamics	168
Figure 6.10 Pipes market forecast	170
6.5 Metering Control	171
6.5.1 Concept	171
6.5.2 How does the technology work?	171
Figure 6.11 The relationship between meter transmission units (MTU),the data collector unit (DCU), the network control computer and the utility company	172
6.5.3 Advantages	172
Figure 6.12 The effect of the installation of water meters on consumption in a block of 120 flats in 1980.	172
6.5.4 Issues	173
6.5.5 Potential / Verdict	173
Figure 6.13 Global meter coverage in 101 countries in 2008	173

Figure 6.14 Meters market forecast	174
6.5.6 Major companies offering metering control	175
Figure 6.15 Water meter suppliers: global market share	175
6.6 Water Management Software	175
6.6.1 Market analysis	175
6.7 Decentralised networks	176
7. Water Technology Market Map	177
Appendix A: Interviewees and acknowledgements	178
Appendix B: Classification system	179
Appendix C: References	181
