

Index of Contents

Indices of Contents	i
Abstract.....	x
Resumen	xv
Resum	xx
Chapter I. Introduction	2
1. The Necessity for Water	3
2.1. Wastewaters	6
2.2. Modern concepts related with water and circular economy	12
2. Advanced oxidation processes	13
2.1. Photooxidation processes	13
2.2. Electrochemical oxidation processes	14
2.2.1. The anodic oxidation process	15
2.2.2. The electro-Fenton and (solar) photoelectro-Fenton processes	16
3. Membranes for water treatment	17
2.1. Membrane separation	18
2.2. Membrane systems	18
2.3. Membrane materials.....	20
2.4. Membrane fouling.....	21
2.5. Prevention of fouling.....	22
2.6. AOPs application as fouling prevention	23
4. Advanced integrated technologies and nutrient recovery in UWW treatment ..	23
5. Future perspectives related to the main goal of this Ph.D.	25
Chapter II. Objectives and Experimental Plan	28
1. Objectives	29
2. Experimental plan.....	30
5.2. Assessment of the self-cleaning capabilities of the UF membrane when using high volumes of UWW	32
Chapter III. Materials and Methods.....	35
1. Chemicals.....	37
2.1. Organic microcontaminants.....	37
2.2. Reagents.....	42
2.3. Water matrices.....	43

Indices of Contents

2. Microorganisms	45
3. Analyses	46
3.1 Physicochemical parameters	46
3.1.1. Electrical conductivity and pH measurements	46
3.1.2. Turbidity measurement	47
3.1.3. UV-visible light spectrophotometry	47
3.1.4. Chemical oxygen Demand determination	48
3.1.5. Free Available Chlorine measurement	48
3.1.6. Iron concentration determination	49
3.1.7. Hydrogen peroxide measurement	50
3.1.8. Persulfate measurement	50
3.2 Dissolved organic carbon	51
3.3 Ionic chromatography	52
3.4 Ultra-performance liquid chromatography	53
3.5 Solar radiation measurement	54
3.6 Phytotoxicity, acute- and chronic toxicity determination	54
4 Experimental set-ups and methodology	56
4.2 Fe:EDDS complex preparation	56
4.3 Sand filtration system	57
4.4 Nanofiltration pilot plant	58
4.5 Solar photoelectro-Fenton pilot plant	60
4.6 Solar simulator	64
Chapter IV. Results and Discussion	67
1. The Effects of salinity on NF membranes	70
2 Solar photo-Fenton as tertiary treatment	74
2.2 Treatment with the conventional solar photo-Fenton process at a pH of 3	74
2.3 The application of EDDS for the solar photo-Fenton process at natural pH	75
2.4 The NF operating parameter effect on the solar photo-Fenton process as	77
tertiary treatment at a pH of 3	77
2.5 The Solar photo-Fenton process as tertiary treatment	81
3 Applying Nanofiltration for ammonium recovery	84
4 Treatment of the Nanofiltration concentrate stream by the solar photo-Fenton	86
process at lab and pilot scale	86
5 Treatment of the concentrate stream volumes by electrooxidation	88

6	Determination of acute and chronic toxicity of the Nanofiltration streams	92
7	The fouling and self-cleaning properties of the photocatalytic membrane	96
8	Treatment of the membrane streams by solar photo-Fenton.....	101
9	The membrane retention of the <i>Pseudomonas Aeruginosa</i> bacterial species ..	105
	Chapter V. Conclusions	108
	References	113
	List of abbreviations.....	134
	Annex A	
	Annex B	