

TABLE OF CONTENTS

SUMMARY	III
TABLE OF CONTENTS	V
LIST OF FIGURES	X
LIST OF TABLES	XIII
LIST OF ABBREVIATIONS	XV
1. INTRODUCTION AND PROBLEM STATEMENT	1
2. TRENDS AND DEVELOPMENT OF SOLID WASTE MANAGEMENT	3
2.1 THE CONCEPT OF MUNICIPAL SOLID WASTE MANAGEMENT	3
2.2 INTEGRATED SOLID WASTE MANAGEMENT (ISWM)	4
2.3 TECHNOLOGICAL CONCEPTS OF MUNICIPAL SOLID WASTE TREATMENT	5
2.4 WASTE-TO-ENERGY TECHNOLOGIES	6
2.4.1 THERMAL TREATMENT	7
2.4.2 MECHANICAL BIOLOGICAL TREATMENT	8
2.5 EU LANDFILL DIRECTIVE TO DIVERT WASTE FROM LANDFILLS	11
2.6 DEVELOPMENT AND FURTHER TARGETS OF THE SOLID WASTE MANAGEMENT IN GERMANY	12
2.7 THE RECYCLING OF MSW IN GERMANY	14
3. REVIEW OF MUNICIPAL SOLID WASTE MANAGEMENT IN ARAB REGION	15
3.1 OVERVIEW OF THE ARAB REGION AND THE ENVIRONMENT SECTOR	15
3.2 CURRENT SITUATION OF WASTE MANAGEMENT IN THE ARAB REGION	16
3.3 LEGISLATION AND BASIC PRINCIPLES	16

3.4 FRAMEWORK AND RESPONSIBILITY	17
3.5 SOLID WASTE GENERATION	19
3.6 CHARACTERISTICS OF SOLID WASTE	21
3.7 MUNICIPAL SOLID WASTE MANAGEMENT AND TREATMENT	22
3.7.1 GENERAL MANAGEMENT ISSUES IN DEVELOPING COUNTRIES	22
3.7.1.1 FINANCES AND INFRASTRUCTURE	22
3.7.1.2 COLLECTION AND TRANSPORTATION FACILITIES	22
3.7.1.3 WASTE DISPOSAL	23
3.7.2 WASTE MANAGEMENT IN THE ARAB REGION	23
3.7.2.1 STORAGE AND COLLECTION	23
3.7.2.2 RECYCLING AND RECOVERY	24
3.7.2.3 MSW DISPOSAL	24
4. ASSESSMENT OF MIXED MUNICIPAL SOLID WASTE COMPOSTING PRODUCED IN THE ARAB REGION	26
4.1 QUALITY OF COMPOST PRODUCED FROM MSW	27
4.2 MIXED MSW MANAGEMENT	29
4.2.1 MIXED MSW DEFINITION	29
4.2.2 CHARACTERISTICS OF MIXED MSW	29
4.2.3 COLLECTION OF MIXED MSW	30
4.2.4 PROCESSING AND RECYCLING OF MIXED MSW	30
4.2.5 COMPOSTING OF MIXED MSW	31
4.3 STUDY MATERIALS	32
4.4 METHODS OF ANALYSIS	33
4.5 RESULTS AND DISCUSSION	33
4.5.1 MOISTURE CONTENT	34
4.5.2 ORGANIC MATTER	35

4.5.3 RESPIRATION ACTIVITIES	36
4.5.4 HEAVY METALS	37
5. BIODRYING FOR MBT OF MIXED MSW AND POTENTIAL FOR RDF PRODUCTION	41
5.1 MECHANICAL BIOLOGICAL TREATMENT (MBT)	41
5.1.1 MECHANICAL SORTING COMPONENT	43
5.1.2 BIOLOGICAL PROCESSING COMPARTMENT	43
5.2 BIODRYING OF MIXED MSW- PILOT PROJECT IN BEJA CITY, TUNISIA	45
5.2.1 SCOPE OF THE PROJECT	45
5.2.2 INSTALLATION OF THE DEMONSTRATION PLANT	47
5.2.3 BIODRYING CONCEPT	49
5.2.4 MATERIAL AND METHODS	50
5.2.4.1 INPUT MATERIAL (MSW)	50
5.2.4.2 CHARACTERISTICS OF THE MSW	50
5.2.5 SAMPLING AND ANALYTICAL METHODS FOR INPUT MATERIAL	54
5.2.6 SAMPLING AND ANALYSIS FOR THE COARSE FRACTION (>80 MM)	54
5.2.7 EXPERIMENTAL MONITORING	56
5.2.8 RESULTS AND DISCUSSION	57
5.2.8.1 CHARACTERISTICS OF THE MSW	57
5.2.8.2 SIZE DISTRIBUTION OF FRESH WASTE	59
5.2.8.3 THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF MSW	61
5.2.8.4 SCREENING AT 80 MM AND MASS BALANCE	62
5.2.8.5 CHARACTERIZATION OF THE COARSE FRACTION	65

5.2.8.6 CHEMICAL PROPERTIES OF THE RDF	68
5.2.8.7 FINE FRACTION CHARACTERISTICS AFTER THE BIODRYING PROCESS	74
5.2.8.8 STABILIZED MATERIAL PRODUCED/ COMPOST LIKE OUTPUT (CLO)	75
6. POSSIBLE WASTE TREATMENT ALTERNATIVES DESIGN FOR MIXED MSW AND ECONOMICAL FEASIBILITY IN THE ARAB REGION	78
6.1 MECHANICAL BIOLOGICAL TREATMENT (MBT)	78
6.2 MECHANICAL BIOLOGICAL STABILIZATION (MBS) WITH BIOLOGICAL DRYING,	78
6.2.1 MECHANICAL TREATMENT	79
6.2.2 BIOLOGICAL TREATMENT	79
6.3 PROPOSED STRATEGIES FOR MSW TREATMENT WITH MBT FACILITIES	79
6.3.1 STRATEGY ONE: BIOLOGICAL DRYING OF MIXED MSW WITH RDF PRODUCTION AND RECYCLABLES RECOVERY	80
6.3.2 STRATEGY TWO: BIOLOGICAL DRYING OF MIXED MSW WITH RDF AND METAL RECOVERY AND STABILIZATION OF ORGANIC MATERIAL BEFORE LANDFILLING.	81
6.4 ECONOMIC FEASIBILITY ANALYSIS	83
6.4.1 COST ESTIMATION AND ECONOMICS	83
6.4.1.1 CAPITAL COST	84
6.4.1.2 OPERATION AND MAINTENANCE COSTS	84
6.4.1.3 GATE FEES AND RDF PRICE	86
6.4.2 COST ANALYSIS WITH CAPITAL INVESTMENT COST	89
6.4.3 COST ANALYSIS WITHOUT CAPITAL INVESTMENT COST	92

6.5 FURTHER DEVELOPING FOR SUSTAINABLE SOLID MANAGEMENT SYSTEM SWM SYSTEM	93
6.5.1 SEPARATE COLLECTION OF MSW	94
6.5.2 COOPERATION BETWEEN MUNICIPALITIES, PRIVATE SECTOR AND INTERNATIONAL COMPANIES	95
6.5.3 WASTE TO WATER TECHNOLOGY (W2W)	96
7. CONCLUSIONS	98
8. RECOMMENDATION	101
REFERENCES	103
THESIS	117
APPENDIXES	121