

Active Municipal Waste Landfill Operation: A Biochemical Reactor

by

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Abstract

The practice of landfilling of solid waste has evolved to produce a complex engineered facility. So-called advances in the design and operation of the modern landfill have resulted in a tendency to place waste material in a water-tight vessel, creating an environment which inhibits waste degradation. Under proper conditions, the rate of municipal solid waste biodegradation in a landfill can be stimulated and enhanced. Environmental conditions which most significantly impact biodegradation include pH, temperature, nutrients, absence of toxins, moisture content, particle size, and oxidation-reduction potential. One of the most critical parameters to MSW biodegradation has been found to be moisture content. Moisture content can be most practically controlled via leachate recirculation. Leachate recirculation provides a means of optimizing environmental conditions within the landfill providing enhanced stabilization of landfill contents as well as treatment of moisture moving through the fill.

Laboratory and pilot-scale studies have shown that moisture control permits rapid stabilization of waste, enhanced gas production, and improved leachate quality; reducing long-term environmental consequences and liability of waste storage and improving the economics of landfilling. Several dozen landfills have initiated efforts to recirculate leachate and full-scale documentation of the efficiency of this practice is now becoming possible.

This document describes experiences with bioreactor landfill operations from laboratory to full-scale. Studies which document the impact of bioreactor operation have been provided and operating and design criteria based on state-of-the-art facilities are described.

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Foreword

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites and ground water; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

Contents

Abstract	ii
Foreword	iii
Figures	vii
Tables	ix
List of Abbreviations	xi
Acknowledgment	xii
Section 1. Introduction	1
Section 2. Executive Summary	4
Introduction	4
Full-Scale Bioreactor Landfills	4
The Impact of Leachate Recirculation on Leachate and Gas Characteristics	5
Landfill Bioreactor Design	7
Landfill Bioreactor Operation	9
Section 3. Regulatory Status	12
Section 4. Literature Review - Landfill Bioreactor Studies	17
Laboratory-Scale Studies	17
Georgia Institute of Technology Experiment I	17
University of Louisville Experiment	19
German Experiment	20
Newcastle University Experiment	21
Georgia Institute of Technology Experiment II	22
Pilot-Scale Bioreactor Studies	23
Sonoma County, California	23
Georgia Institute of Technology Study	25
Mountain View Landfill, California	26
Binghamton, New York (New York State Energy Research and Development Authority)	29
Breitenau Landfill	31
Brogborough, United Kingdom	31
Full-Scale Landfill Bioreactor Studies	33
Lycoming County, Pennsylvania	33
Leachate Management Facilities	33
Leachate Recirculation Techniques	34
Leachate Quantities	34
Leachate Quality	35
Gas Production	36
Settlement	38
Conclusions	38
Seamer Car Landfill, United Kingdom	39
Delaware Solid Waste Authority	39

German Experience	42
Bornhausen Landfill, Germany	42
Section 5. Full-Scale Experiences with Bioreactor Landfills - Case Studies	48
Introduction	48
Southwest Landfill, Alachua County, Florida	48
Central Facility Landfill, Worcester County, Maryland	52
Winfield Landfill, Columbia County, Florida	52
Pecan Row Landfill, Lowndes County, Georgia	55
Lower Mount Washington Valley Secure Landfill, Conway, New Hampshire	58
Coastal Regional Solid Waste Management Authority Landfill, Craven County, North Carolina	58
Lemons Landfill, Stoddard County, Missouri	59
Mill Seat Landfill, Monroe County, New York	62
Yolo County Landfill, California	67
Additional Full-Scale Efforts	67
Section 6. The Impact of Leachate Recirculation of Leachate and Gas	71
Characteristics	71
Introduction	71
Leachate and Gas Characteristics at Conventionally Operated Landfills	71
Phase I - Initial Adjustment Phase	71
Phase II - Transition Phase	71
Phase III - Acid Fermentation Phase	73
Phase IV - Methane Fermentation Phase	73
Phase V - Maturation Phase	73
Leachate Characteristics	73
Gas Characteristics	76
Leachate Characteristics of Recirculating Landfills	76
Fate and Transport of Priority Pollutants	77
Comparison of Waste Stabilization Rates	79
Leachate Treatment Implications	82
Leachate Quantities	82
Gas Production	84
Section 7. Landfill Bioreactor Design	85
Introduction	85
Liner/ Leachate Collection System	85
Leachate Storage	86
Leachate Reintroduction Systems	89
Prewetting of Waste	89
Leachate Spraying	92
Surface Ponds	92

Vertical Injection Wells	92
Horizontal Subsurface Introduction	93
Device Placement	93
Final and Intermediate Caps	96
Gas Collection	96
Cell Construction	97
Summary	98
Section 8. Landfill Bioreactor Operation	100
Introduction	100
Waste Characterization	100
Oxidation-Reduction Conditions	101
Moisture Content	102
Recirculation Strategies	103
Effects of Waste Placement rate	105
Use of Old Cells	106
Bioreactor Augmentation	109
Temperature Control	111
Nutrients	111
Buffering	111
Inoculation	112
Daily and Intermediate Covers	112
Settlement	113
Monitoring	113
When is the Waste Stable?	114
Conclusion	117
References	118
Appendix A - Survey of State Regulators - Leachate Recirculation	
Appendix B - Conventional Landfill COD Data	
Appendix C - Hydrodynamic Modeling of Leachate Recirculating Landfill	
Appendix D - Mathematical Modeling of Recirculating Landfill Leachate Quality - Methodology	

Figures

<u>Number</u>		<u>Page</u>
1	Schematic diagram of the landfill bioreactor...	3
2	Leachate recirculation system, Alachua County, FL Southwest Landfill	50
3	Horizontal injection system (HIL), Alachua County, FL Southwest Landfill	51
4	Leachate recirculation system, Worcester County, Maryland Landfill	53
5	Vertical leachate recharge well, Worcester County, Maryland Landfill	54
6	Pecan Row Landfill (Valdosta, GA)..	56
7	Pecan Row Landfill (Valdosta, GA) recirculation line detail	57
8	Lemon Landfill (Dexter, Missouri)	60
9	Lemon Landfill (Dexter, Missouri) leachate recirculation details	61
10	Mills Seat Landfill (Rochester, New York) recirculation layout elevation 215 m)	63
11	Mills Seat Landfill (Rochester, New York) recirculation layout elevation 224 m)	64
12	Mills Seat Landfill (Rochester, New York) recirculation layout elevation 233 m)	65
13	Mills Seat Landfill (Rochester, New York) prefabricated horizontal infiltration field with chimney.	66
14	Yolo County Landfill (California) test cells	68

<u>Number</u>		<u>Page</u>
15	Yolo County Landfill (California) leachate distribution system layout	69
16	Stabilization phases of waste degradation in a landfill	72
17	Fate and transport mechanisms for contaminants in MSW landfills	78
18	Leachate COD from conventional landfills	81
19	Typical Behavior of chloride in conventional and recirculating landfills	83
20	Effect of leachate recirculation on leachate generation	83
21	Effect of leachate storage on off-site treatment requirements	87
22	Influence distance of horizontal trench	94
23	Schematic diagram of leachate recirculating landfill	99
24	Effect of waste placement rate on leachate quality	107
25	Leachate recirculation scenario - two cell sequencing	108
26	Leachate recirculation scenario - closed cell	109
27	Comparison of leachate quality for single and sequencing cells	110

Tables

<u>Number</u>		<u>Page</u>
1	1993 Status of recirculation in the United States	14
2	Column loading characteristics	22
3	Test cell moisture condition, Sonoma County	24
4	Cell composition after construction, Mt. View	27
5	Cell construction characteristics and monitoring results (1597 days), Mt. View	28
6	Refuse chemical analysis summary, Mt. View	28
7	Cell composition data, Binghamton, New York	30
8	Leachate Quality Data, from day 350 to day 600, Binghamton, New York ...	30
9	Leachate quality data for test cell 2, Breitenau, Austria	32
10	Water budget, Lycoming County	36
11	Leachate parameter values, Lycoming County	37
12	Lagoon effluent quality, Lycoming County	37
13	Total quantities of leachate generated and recirculated annually, Delaware ...	40
14	Leachate quality data for Area B, DSWA	41
15	BOD and COD removal by two stage leachate recirculation, Bornhausen Landfill	43

<u>Number</u>		<u>Page</u>
16	Summary of bioreactor investigations	45
17	Full-scale leachate recirculating landfill water balance data	49
18	Landfill constituent concentration ranges as a function of the degree of landfill stabilization	74
19	Leachate constituents of conventional and recirculating landfills	77
20	COD and chloride half-lives in laboratory, pilot and full-scale leachate recirculation studies	80
21	Ratios of COD/chloride half-lives	81
22	Comparison of frequently used leachate recirculation devices	90
23	Full scale leachate recirculation hydraulic application rates	91
24	Refuse hydraulic conductivity	105
25	Bioreactor process performance monitoring	115

List of Abbreviations

AA	-- acetic acid
BOP	-- biological methane potential
BOD	-- biochemical oxygen demand
C	-- Celsius
COD	-- chemical oxygen demand
CSWMA	-- Coastal Solid Waste Management Authority
CSWMC	-- Central Solid Waste Management Center
d	-- day
DSWA	-- Delaware Solid Waste Authority
ft	-- feet
ha	-- hectare
kg	-- kilograms
l	-- liters
lbs	-- pounds
LFG	-- landfill gas
lpm	-- liters per minute
m	-- meters
MSW	-- municipal solid waste
NA	-- data not available
NYSERDA	-- New York State Energy Research and Development Authority
SC	-- specific conductivity
SUTRA	-- Saturated and Unsaturated Transport
TDS	-- total dissolved solids
TOC	-- total organic carbon
tpd	-- tons per day
TPD	-- metric tons per day
TS	-- total solids
TSS	-- total suspended solids
TVA	-- total volatile organics
TVS	-- total volatile solids
USGS	-- United States Geological Service
USEPA	-- United States Environmental Protection Agency

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