
Reuse and Remediation of Closed Landfill in Korea

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Abstract

A recent survey investigated that there were over one thousand un-controlled closed landfills(1,072 sites) in Republic of Korea. Most of these landfills were constructed before 1986. Waste management act were not promulgated at that time, so they usually do not have drainage system and leachate treatment facility. Also, considerable attention has been received to landfill leachate pollution, leachate has an adverse impact on the surrounding environment such as soil, groundwater, and water supply source. According to the result of survey for closed landfill management, it was reported that 875 sites out of 1,072sites(81.6%) have no leachate treatment facility and 630 sites out of 1,072sites(58.7%) have been used for farm lands and residence. Consequently it is hard to do postclosure care continuously in most of cases and these uncontrolled landfills have contaminated farm lands and residence. The average age of these landfills are ranged mostly between 2 to 15 years. Much time and advanced technology are needed to remediate these uncontrolled landfills, therefore the survey for

present status of closed landfill sites is required and suitable treatment processes should be prepared. With this point of view, We has been investigated to find out the present status of closed landfill, problems of post management and discussed plans for remediation and reuse.

Remedial actions of un-controlled landfill have been carried out the many cities since 1997 upto now. Most frequently applied technology were reuse after excavation and there were several cases to capping in the surface of landfill and to construct subsurface barriers. It is considered that landfills in use have a possibility not to be controlled because of inadequate construction and improper management. Therefore remediation of uncontrolled landfills and recovery technology should be develop continuously

Especially, it has been expected that resource technology of landfill gas as a energy has some advantages in controlling odors in the site area and accelerating stabilization of landfills with the energy.

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Status of Closed Landfills in Korea(2001)

Item	Total	Capacity		Construction Certification		Leachate treatment method		etc
		Over 10,000 m ³	Under 10,000 m ³	Approved	Non-approved	Self-treatment disposal	Transfer to treatment disposal	
Number of sites	1,072	242	830	294	778	69	128	875
(%)	(100)	(22.6)	(77.7)	(27.4)	(72.6)	(6.4)	(12.0)	(81.6)
Leachate (m ³ /D)	6,317							
Age of closed landfills				State of use				
Under 5yr	5-10yr	10-15yr	Over 15 yr	Residence	Factory land	Farm land	No use	etc
226	538	236	72	54	132	444	398	46
(21.1)	(50.2)	(22.0)	(6.7)	(5.0)	(12.3)	(41.4)	(37.0)	(4.3)

The problems of closed landfill in Korea

- Illegal dumping without leachate collection and treatment facility, most of closed landfills were constructed before the promulgating of waste management act (1986)
 - concerned about the contamination of groundwater or soil
- difficult post-management because of already use for residence, farm land or etc (630 sites out of 1,072 sites).

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The procedure of decision for the remediation technologies of Uncontrolled landfill

RI : Remedial Investigation FS : Feasibility study

- | | |
|-------------------------------------|--------------------------------------|
| 1. Description of Current Situation | 5. Description of Proposed Response |
| 2. Site Investigation | 6. Preliminary Remedial Technologies |
| 3. Laboratory & Bench-scale Studies | 7. Development of Alternatives |
| 4. Community Relation Support | 8. Evaluation of Alternatives |
| | 9. Final Report |

The detail estimation items of alternatives

Item	Details of estimation
Technical part	1. The capacity of treatment and removal of contaminants - the efficiency of treatment and removal - expected operation span
	2. Technical confidence - operation and maintenance - actual results at present
	3. Actual application of technologies - establishment and construction - accession to engineering work
Environmental part	1. The investigation of adverse impact on the environment by alternatives
	2. Minimization of adverse impact
	3. The cost for minimization of impact on environment
Public health	1. The investigation of contamination at present
	2. The effect on human exposed by present concentration
	3. The comparison between optimum concentration legal standards and goal
	4. The capacity comparison of treatment and control in each plan
Regulations	1. Neither following the regulations the technical application nor the other
	2. Neither achievement of regulation standard for contamination concentration nor the other
	3. Neither following the regulations on time nor the other
cost	1. Construction: equipment, manpower, raw material
	2. Technology, equipment
	3. Land and local development
	4. Facilities management and service
	5. Residents migration and resettlement funds

Remediation technologies of uncontrolled landfill in domestic and foreign

Off-site treatment

- The method by migrating and reuse the excavation waste
- improvement in short term
 - perfect removal of contamination sources
 - possible land reuse
 - need for new land for landfill, owing to re-landfilling

Selective off-site treatment (selective excavation waste)

- The excavation waste would be separated into combustible and recycling materials, and then incinerate and recycle in each, and the landfill reuse another purpose.
 - Advantage
 - : High technical/economical value and good utilization of excavated landfill, possible recovery of valuable materials.
 - Disadvantage
 - : Production of odor and hazardous landfill gas at excavation and selection working time.
 - Possibility of the hazard to health and safety of workers.
- Applied technology
 - Landfarming
 - Biopile
 - Soil Washing
 - Electrowave

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In-situ stabilization

- The way how the transfer and convection of pollutants be isolated by using of cover material and cut-off wall, instead of not excavating the landfill.
 - Relatively passive method which can be applied to the regions of non-requirement of quick improvement.
 - Disadvantage : the long-term existence of pollutants until the landfill be stable properly.
- Applied technology
 - Slurry Walls
 - Grout Curtain
 - Sheet Piling
 - Reactive Wall
 - Soil Cover
 - ET Cover
 - Single barrier Cover
 - Composite barrier Cover

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Earlier stabilization

- The shortening the stabilization period which be proceeded in various reduction stage.
- Applied technology
 - ATAS (Auto Thermic Aerobic Stabilization)
 - HABS (Hybrid Aerobic Bio-Stabilization System)
 - Smell Well System
 - Bio-puster
 - Air-O-flox
 - Landfill-mining
 - Leachate recirculation

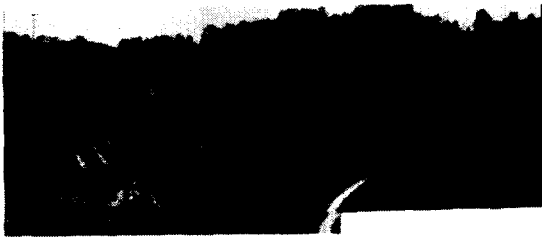
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**The example of remedial action
by surface capping technology (Sanghyo-dong, Jeju)**



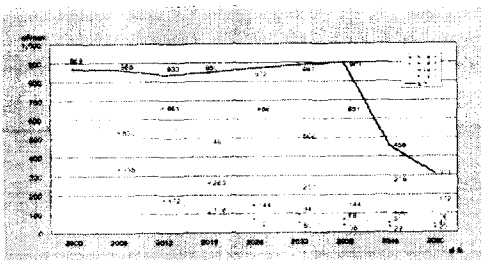
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**The example of remedial action
by excavation and reuse technology (Olcheon)**



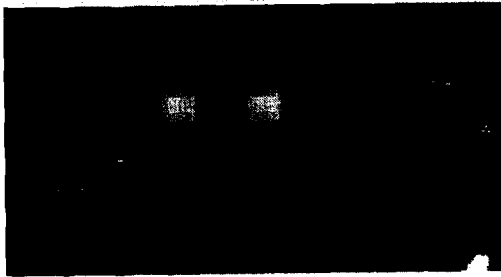
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The estimated LFG generation of metropolitan(Sudokwon)-landfill



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The system diagram of the electric power facility by the using LFG



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The summary of landfill objected to LFG resource development

Landfill sites	Operation period		Landfill capacity(m ³)	Estimated LFG generation (1000 m ³ /day)	Estimated generation of electric power (MW)
	start	close			
Saenggok, Pusan	'96	2001	11,438	210	11
Dalsung, Daegu	'91	2000	26,100	480	25
Woonjung, Kwangju	'93	2000	4,369	80	4
Kumkok, Daejeon	'98	2010	8,485	156	8
Heungup, Wonju	'95	2005	3,140	58	3
Moonmak, Chungju	'94	2000	1,860	33	2
Daeyang, Mokpo	195	2004	2,897	53	3
Hodong, Pohang	'94	2001	1,208	22	1
Chuncheon, Changwon	'92	2020	3,810	70	4
Naedong, Jinju	'93	2001	5,855	108	6
Yousan, Yangsan	'95	2005	3,019	56	3
Hacheon, Cheju	'92	2002	2,416	44	2
Total	-	-	77,578	1,370	72

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The prospect of landfill management of Korea

- The prohibition of direct landfilling of specific waste
 - Waste tire, waste furniture etc. (since Jan. 2001)
 - The organic waste (from July. 2003)
 - Food waste (from Jan. 2005)
- The subdivision of the category of landfill and reinforcement of the standards of landfill management.
- The reinforcement of the standards of post management of landfill
 - The adjustment of the periods of post management by the results of the characteristics and the environmental effects of landfill.
 - The development of the resource recovery technology of LFG suited to the Korea
 - The adjustment of the recycling system for the reduction of LFG to the environment such as incineration, generation of electric power etc.

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