RecShow '08

Middle East Recycling, Waste & Environmental Management Exhibition & Congress

Kempinski Hotel, Dead Sea - Jordan

17-19 February 2008

Solid Waste Management in Jordan

Present Situation and Future Challenges

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December, 2007

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Introduction

THE RAPID INCREASE IN POPULATION AND THE CHANGES IN LIFE STYLE IN JORDAN HAVE RESULTED IN A DRAMATIC INCREASE IN QUANTITIES OF SOLID WASTE. SUCH QUANTITIES ARE BEING DUMPED DAILY IN LANDFILLS TO GIVE LARGE ACCUMULATIONS OF WASTE CAUSING A THREAT TO THE ENVIRONMENT AND OCCUPYING CONSIDERABLE AREAS OF LAND. THIS REQUIRES ADOPTING THE BEST AVAILABLE SOLUTIONS IN WASTE MANAGEMENT UTILIZING ALL FEASIBLE TECHNOLOGIES TAILORED TO THE SPECIFIC SITUATION IN JORDAN.

1- Present Situation

1-1 Quantities of Municipal Solid Waste in Jordan

The average generation rate per capita of municipal solid waste in Jordan is (0.8kg/day). It varies, however, in cities and rural areas. The generation rate may be as high as (1.0kg /day) in big cities, where as in small cities and rural areas it might be as low as (0.6kg/day).

The quantities of solid waste generated in Jordan are estimated to be 4,600 tons per day (1,679,000 tons per year) most of these quantities are collected by municipalities and transferred to landfills throughout the country (20 landfills).

1-2 Collection & Transport

Solid waste collection is the responsibility of Municipalities. Curbside collection in 1.1 m3 containers and house to house collection in 0.22m3 containers or plastic bags are the methods used for waste collection.
Private companies collect some commercial and industrial waste with contracts to organize the process.
Collection vehicles transport the waste after collection to landfills.
The Ministry of Municipal Affairs is implementing a project to establish (14) transfer stations in Jordan four of which are already in operation. The waste is collected from points of generation then transported to transfer stations in small compactor vehicles then it is emptied in larger vehicles before it is transported to the landfills.

1-3 Method of Disposal

The method of final disposal of solid waste in Jordan is land filling. It is considered the best method for Jordan due to its low cost and the availability of land required.
Land filling, practiced in Jordan, is simply dumping the waste in trenches or cells with leveling and compacting by trash compactors or heavy machinery to reduce the size and the thickness of the layers, and finally the application of daily and final soil cover.
Land filling using trench method is most popular, cell method is used depending on the topography of the site
No lining is applied to landfills and no leachate collection and biogas utilization, except in Russaifa and Al Ghabawi sites.

1-4 Landfill Disposal Sites

- **There are 20 landfill sites in Jordan operated by Common Service Councils (branching from the Ministry of Municipal Affairs).This is after the recent closure of 7 small landfill sites. The landfill sites receive not only municipal solid waste but also Industrial and commercial solid waste and other solid and liquid wastes.**

Table (1) shows the working landfill sites in Jordan.

	Name of Site	Governorate	Area (hectare)	Quantity of Waste (ton/day)
1	AL-EKADER	Irbid	80.6	**700**
2	HUSAINEAT	Mafraq	18	**170**
3	NORTH BADIA	Mafraq	36	**43**
4	Al RUAISHED	Mafraq	17.9	**3**
5	ALHAMRA (SALT)	Al Salt	27.5	**450**
6	AL-GHABAWI	GAM*	194.7	**2500**
7	MADABA	Madaba	13.6	**500**
8	DHULIL	Zarka	14.5	**160**
9	DIAR ALLA	Balqa	36.3	**210**
10	AZRAQ	Zarka	25	**15**
11	NORTH SHUNEH	Irbid	7.6	**290**
12	GHOR ALMAZRA'A	Karak	20.5	**20**
13	LAJOON	Karak	48.5	**190**
14	GHOR ALSAFI	Karak	15.3	**25**
15	TAFILAH	TAFILAH	45	**80**
16	ALMOHAMADEH	Ma'an	44.4	**80**
17	EYIL/NEIMAT	Ma'an	27.4	**42**
18	MA'AN	Ma'an	50.2	**120**
19	AL-QUAIRA	AQABA	27	**25**
20	AQABA	AQABA	6	**150**

*Greater Amman Municipality

Table (1)

1-5 Landfill Sitting Criteria

The process of new landfill site selection in Jordan is not performed according to a specific criterion .It starts in the MOE where an ad-hoc committee is formed with members from all concerned parties. Each committee member gives his opinion about the proposed site during and after the site visit. If all parties agree that the proposed site is suitable for locating the new landfill, the MOE will consider that particular site as the new and formal site.

1-6 Waste Constituents

Municipal solid waste in Jordan is characterized by a high organic content, this is due to the life style where a lot of food ends in the waste and due to market system (i.e. vegetables are sold unprocessed with roots and leaves attached). Related to that solid waste contains high water content, around 60%.

Studies were made by the former General Corporation of Environment Protection (GCEP) - now Ministry of Environment and Japan International Cooperation Agency (JICA) on solid waste samples from selected residential areas in the three regions (North, Middle and South). The results are shown in Table (2):

Content	Average % (Mafraq, Madaba & Maan)*
Kitchen garbage	**62.6**
Plastic	16.5
Paper	11 .2
Fiber/textile	4 .3
Glass	2 .1
Metals	2 .1
Others	1.2

Table (2) Composition of M.S.W (%)

1-7 Treatment of SW in Jordan

Partial and unorganized separation of recyclable materials, paper, metals and plastics (in landfills and outside) is practiced in most parts of Jordan. Most of separation is performed by private sector through contracts. Separated materials are recycled to make new products.
Organic waste separated from vegetable market, Amman Municipality slaughterhouse and food waste separated from selected restaurants is transported to the biogas plant located near Russaifa landfill to be treated anaerobically in a reactor to generate biogas and electricity.

1-8 Private Sector Participation in Waste Management

Private sector participation in waste management in Jordan is limited to:

- **Separate of waste in landfills by private contractors**
- **Collection and transport of commercial and industrial waste is practiced, in few cases, by private companies.**
- **A recycling center is to be established next to Al Ghabawi landfill to separate recyclables from a portion of the waste generated in Amman.**

1-9 Role of MOE in Solid Waste Management

- **Preparation of legislations in SWM**
- **New landfill sitting (in cooperation with concerned parties)**
- **Monitoring the performance of landfill sites.**
- **Study the influence of landfill sites on the environment**
- **Preparation of plans, studies and data collection and analysis in SWM**

- **Specify suitable equipment and methods of collection, transport, separation, storage, recycling, treatment and disposal.**
- **Specify methods of rehabilitation of closed landfill sites**
- **Carryout training and public awareness programs in the field of SWM**

1-10 Progress Achieved by MOE

- **Legal approximation with EU legislations**
- **Preparation of waste framework law**
- **Institutional strengthening New divisions/ functions**
- **Preparation of solid waste policy**
- **Adoption of EU waste catalogue**
- **Preparation of waste manifest system**

- **Carryout cleaning n public p**

2- Negative Aspects of SWM in Jordan

2-1 Inadequate legislations

The following negative aspects are noticed in the present legislations:

- Weaknesses in the existing legislations.
- Many aspects of solid waste management are not covered by the existing legislations.
- Some duplications and contradictions within the existing legislations.

2-2 Waste Generation /Segregation/ collection

The following negative aspects are noticed:

- No proper waste minimization policy.
- No proper separation of waste at points of generation.
- Lack of awareness among people with regard to waste handling, reduction and treatment.
- Low education and training among waste collection personnel.

2-3 Transport of waste to landfill:

-Long distances to some landfills and thus high cost of transport.
- Improper locations of some transfer stations eliminate the benefit of them since the distance traveled to deliver the waste to the landfill is almost the same.

2-4 Waste Treatment:

- Minor separation of recyclable materials from waste stream, recycling and resource recovery are done on small scale.
- No treatment of the organic potion in the waste stream.
- Waste hauled to transfer stations is compacted leaving no chance to waste separation and treatment.
- No pilot projects were implemented in waste treatment as success indicators of different treatment methods.

2-5 Landfill sites:

- Improper location of some landfill sites (above ground water basins or in areas with rocky nature).
- Lack of new landfill sitting criteria.

- No lining is applied to landfills and no studies were conducted to prove the necessity of lining. (Al Ghabawi landfill site is an exception).
- No lechate collection and no landfill gas ventilation and /or collection (Russaifa biogas plant and Al Ghabawi landfill sites are exceptions).
- Unorganized landfill practices, methods and area efficient use.
- Lack of heavy machinery in some landfill sites.
- Absence of weigh bridges on the entrances of landfill sites to weigh the collection vehicles in order to know the exact amounts of waste entering the sites.
- Improper and unorganized separation of recyclable materials is done in unsanitary conditions and influencing land filling practices.
- Infrequent health checkups to landfill workers and improper measures of protection.
- Improper infrastructure in some landfill (i.e. office, fence, access road, etc.).
- No benefit from Clean Development Mechanism-carbon finance (CDM) by methane gas reduction.

3- Future Challenges & Recommendations

3-1 Developing solid waste Management Legislations

1) Legislations related to landfill sites and waste treatment

Background

Environmental legislations in the field of solid waste management are considered the basic issue in successful treatment and disposal of solid waste in an environmentally sound way. Legislations provide control on waste management leading to more efficient practices.

The aim of having legislation on waste management is to:

1- Identify the proper environmental and economic practices of waste management.
2- Protection of natural resources.

Main objective

Prepare the suitable legislations through which proper SWM can be achieved.

Specific objectives

- Identify the weaknesses in the existing legislations and develop them to cover such weaknesses.
- Prepare new legislations for the areas not covered by the existing ones.
- Identify duplication and contradictions in the existing legislations.

2) Legislations on packaging waste and producer responsibility

Background

Packaging materials are increasingly adding large amounts of waste to the waste stream to the extent that makes it necessary to employ all possible solutions to reduce and recycle such waste.

Main objective

Reducing quantities of packaging waste and employing an effective method of collection

Specific objectives

- identify quantities of packaging waste
- use of environmentally friendly materials
- recover and recycle packaging waste

3) Agricultural Waste Treatment

Background

Agricultural waste, plant and animal, is increasing with population growth and increasing need for food.

Such waste, if not treated in proper methods, could result in health and environment problems. This problem is apparent in the Jordan Valley due to the application of animal waste on land.

Main objective

Treatment of agricultural waste to benefit from instead of being a source of pollution

Specific objectives

- agricultural waste treatment to produce fertilizers
- power generation from waste

4) Legislation on Establishing Biogas plants

Background

The Jordanian experience in utilizing waste to produce biogas and electricity in Russaifa landfill is an encouraging experience to make replicable projects in other parts of Jordan

Main objective

Build new bioreactors to produce methane gas

Specific objectives

- methane gas utilization from other landfills
- awareness among farmers to establish small reactors in their farms

5) Investment Promotion

Background

"There is treasure in trash" a saying that is practically true through recycling and energy production from waste in addition to environmental benefits gained.

Main objective

Investment promotion in waste recycling and treatment for local and foreign investors.

Specific objectives

- Establish biogas plants in other parts of Jordan.
- Encourage waste separation, recycling and treatment.

6) Implementing clean development mechanism (CDM)

It is important that Jordan gets the benefit from the carbon finance implemented through the Kyoto protocol in the field of clean energy production and reduction of green house gases.

Main objective

- Help in creating clean global environment.

Specific objectives

- Implement projects than benefit from CDM to cover costs of certain projects.

3-2 Public Awareness and training

- Training of staff for Common Services Councils, municipalities and Ministry of Environment.
- Public Awareness among general public with regard to waste handling, reduction and treatment.

3-3 Waste Separation and recycling

Waste separation at point of generation is not easy to accomplish in Jordan due to several reasons:

- Lack of awareness among the public regarding waste issues (recycling, treatment and value of waste)
- The unwillingness among the majority of people to cooperate in waste separation. This was apparent through pilot projects in different districts in Amman.
- A comprehensive system of waste separation with special types of containers, special collection vehicles and collection schedule is costly and not easy to organize and operate.
- Lack of space within districts and neighborhoods to place several containers for different constitutes of waste.

Therefore, the proposed alternative for waste separation is recycling centers located within the disposal sites.

The recycling centers should utilize low technology to reduce capital and operational costs.

A moving belt and containers for different recyclables allows hand sorting of waste and creates job opportunities.

3-4 Treatment of organic waste

Organic waste can be land filled after the removal of recyclable materials, thus producing biogas which can be used to generate electricity or it can be treated aerobically to produce compost.

In both cases CDM carbon finance will support such projects, since the final results is green house gases (methane gas) reduction.

Therefore the following actions are proposed:

- Land filling should be practiced where large amounts of waste are dumped ensuring exploitable amounts of biogas.
- Composting should be practiced with less amounts of waste and where biogas generated is not enough to be economically feasible.
- Pilot projects for composting should be implemented before large scale treatment projects to make sure this method of treatment is successful in Jordan.

3-5 Landfill Sites

The Fact that twenty landfill sites in Jordan are in operation has several disadvantages:

1. Landfill sites may be considered as sources of pollution specially at their present condition and should be reduced in number.
2. Management, control and monitoring are less efficient with increasing number as landfills.
3. The distribution of funds available to twenty landfill sites results in an inadequate construction, management and operation of the sites.
4. To distribute the total quantity of the waste generated in Jordan over twenty landfill sites results in small accumulation of waste in each landfill site and consequently not enough waste to produce exploitable and feasible amounts of biogas that can be used to generate electricity.

Therefore, the following scheme is proposed:

1. Reduction of the number of landfill sites to three central sites which are:
2. Properly located according to proper sitting criteria.

- Properly designed and constructed on sanitary basis taking into account lining of landfill, lechate collection and treatment and biogas extraction and utilization.
- Al Ghabawi landfill site can be considered as one of these sites since it's a sanitary landfill.

3. The use of transfer stations, properly located and with large transport vehicles to eliminate the influence of large distances between collection areas and landfill sites. Waste compaction in transfer stations should be avoided to allow for waste separation before final disposal.
4. Closure and rehabilitation of remaining landfill sites.
5. Benefit from Clean Development Mechanism (CDM) -carbon finance should be considered.

Biography

Name: Khalid Metab Alfayez

Nationality: Jordanian

Date of Birth: 13-8-1965

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Education:

M.sc. Civil Engineering-Environmental Engineering, 1992.
University of Jordan , Amman-Jordan.

B.sc. Civil Engineering,1987
Mississippi State University
Starkville - Mississippi , USA

Languages : Arabic & English (excellent command)

Computer skills : Microsoft Word, PowerPoint and Internet

Present Job:

(10/2006-present) Head of Policies, Planning & Supervision Division
(2001-10/2006) Head of Solid Waste Management Division
(1993-2001) Environmental Engineer / Researcher
Waste Management Directorate, Ministry of Environment.

Responsibilities:

1. Draft legislations, policies and strategies on (hazardous wastes, solid wastes, chemicals and hazardous substances)
2. Draft national plans related to (hazardous wastes, solid wastes, chemicals and hazardous substances)
3. Follow up the International Agreements
4. Study and recommend to government ratification of new conventions, Agreements and protocols.
5. Landfill site selection.
6. Monitoring of landfill operations and data collection.
7. Implementing projects for improving solid waste management.
8. Implementing projects related to the influence of landfills on the environment.
9. Training in solid waste collection, treatment and disposal.
10. Follow up of general environmental complaints.

Training:

1. Environmental Protection and Pollution Control, a training course, 1995 Hokkaido -Japan.
2. Environmental Protection Technology, a training course,1996,Seoul-Korea.
3. Environmental Policies, a training course,1997,Kuwait.
4. Environmental Management for Industry, a workshop,1999 , Abu Dhabi-UAE.
5. Principles of Solid Waste Management Planning, a training program ,US-EPA,1999 , Amman-Jordan.
6. Solid Waste Management 2000 Part 1,a training course,28/4-27/5/2000,Goteborg-Sweden.

7. Solid Waste Management 2000 Part 2,a training course, 4-15/12/2000,Tegucigalpa,Honduras.
8. Waste Management & Biogas Technology , a training of trainers program conducted by The Technical University of Hamburg , Germany and Farmatic Company , Germany (15 weeks : 4 weeks in Germany , 11 weeks in Jordan) Part of the Biogas Project (capacity building), January-July , 2001.
9. Environmental Management Administration for the Hashemite Kingdom of Jordan , Japan , 2004 .
10. Environmental Management for Municipalities , Lebanon , 2005
11. Chemical Management Policy , Japan , 2-15 July 2006
12. Leadership for sound waste management ,United Nation University-Jordan, 27-30/8/2006
13. Use of Economic Instruments in Environmental Decision Making , US EPA , Jordan, 4-6/9/2006
14. Government Performance Indicators, National Training Institute, 4-7/2/2007
15. Communication Skills , Syria , 29/3-1/4/2007

Conferences and Workshops :

1. Environmental Management for Industry , a workshop ,Abu Dhabi-UAE , 1999
2. The National Workshop for Economic and Social Plan-Environment Sector,Amman-Jordan,1999.
3. Waste Management Annual Conference & Exhibition 2002 , Torbay-England ,2002 .
4. Environmental Awareness in Waste Management and Biogas for NGOs Aqaba-Jordan , 2003.
5. Environment Regional Conference for Industries, Lebanon , 2004
6. Capacity Building Seminar on Hazardous Waste in the Middle East , Helsinki-Finland , 2005
7. Regional Workshop Aimed at Promoting Ratification of the Basel Protocol on Liability and Compensation for Damage resulting from Transboundary Movements of Hazardous Wastes and their Disposal**,** Cairo, October 2006
8. Seminar on Educating Leaders for Waste Management in Jordanian Schools , United Nation University-Jordan, 18-19/3/2007

Projects & Committees:

1- Improvement of Solid Waste Management in Jordan (Equipment for ten major landfill sites in Jordan) , 1994-1996 , JICA.

2- Northern Region Solid Waste Management Study ,1996-1999, METAP.

3- Member of The National Development Plan Committee, 1999-2003, Environment Sector.

4- Member of The Steering Committee for The Biogas Project , 1998-

5- Member of The Steering Committee for The Zarka Solid Waste Management Project , 2001-

6- The Study of the Effect of Landfill Sites on Groundwater Quality in Jordan,2001-

7- Member of the Capacity Building Team (Trainer) in the Biogas Project , 2002-

8- Project of Preparing a Strategy for the Support of Private Sector Participation in Solid Waste Management in Jordan , 2004-

9- Capacity Building in the Calculation of Carbon dioxide Emissions from different sources influencing Climate Change , 2004-

10- Member of the Comprehensive Solid Waste Management Plan Committee ,2005

11- Chairman of Committee for Developing Solid Waste Management Legislations , 2006/2007

12- **FOCAL POINT FOR PROJECT "DEVELOPMENT OF METHODS AND TOOLS FOR THE ESTABLISHMENT OF GOOD ENVIRONMENTAL PERFORMANCE IN THE TOURIST ACCOMMODATION SECTOR IN JORDAN- IMPLEMENTATION OF PILOT STUDIES GREEN-TAS" , 2006/2008**

Lectures:

1- (26) lectures given throughout Jordan covering engineers and workers in all landfills regarding solid waste management and improvement of practices in solid waste collection , transport and disposal , 1997.
2- Solid Waste Management in Jordan, Jordan Environment Society, 2001.
3- Biological Treatment of Solid Waste, Jordanian Engineers Association, 2002.
4- Composting (Aerobic Biological Treatment of Solid Waste) 12 lectures in 12 Governorates in Jordan directed to most concerned parties, 2003.
5- Solid Waste Management in Jordan , 2004
6- Hazardous Waste Management in Jordan , 2005
7- Biogas Utilization , Iraqi Training through JICA , 2005
8- Landfill Site Selection , Iraqi Training through JICA , 2005
9- Development of Solid Waste Management Legislations , 2005
10- Basel Convention , Training of Jordanian Judges,2007
11- Solid Waste Management in Jordan (Jordanian Schools)-Current Situation and Future Challenges ,UNU, Jordan , 2007
12- Institutional Strengthening & Legal Upgrading at the MOE , 2007

Publications:

"Retention of Phosphorus by Selected Jordanian Soils"
A Masters of Science thesis, 1992, University of Jordan.