



Application of Eco-remediation Methodology for Sustainable Landfill

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Abstract: Consolidation of knowledge, information and experiences in application of a design for environment principles is done at various levels. A sustainable and reliable eco- method for rehabilitating landfills has been relying on the descriptive analysis and quantitative to learn the process of collection and transport of polluted wastes in the city of Baghdad. The data were based on documents and reports of Baghdad municipal departments affiliate. A study was conducted for the possibility of reducing the cost transfer of polluted municipal wastes through the application of the Vogel approximate to reach the optimal solution. The hypothesis is the interaction mutual transfer of wastes scientific methods and sustains the environment. This method can control the human being made pollutants which consider to be a source of exploitation and irrational of natural resources. Vogel approximation extents of the transfer of polluted wastes reduce the developments of this process costs of reaching exuberance cost of US\$ 5.96 million, and this represents a resources waste.

Keywords: Eco-remediation, Mutual Transfer Sustainable Environment, Landfill, Vogel Approximation

1. Introduction

During the last decades, Iraq has suffered of the accumulation of polluted wastes problem in Baghdad city. Baghdad Landfilling is the most common form of disposal for waste that cannot be reused or recycled and where there are no thermal waste treatment plants available. Improper landfilling techniques can cause serious environmental problems through ground and surface waters, soil and air contamination. The development of alternative methods for landfill management can provide a more sustainable approach therefore of great interest. The need for the reclamation of landfill sites to avoid the long-term environmental degradation is widely recognized in the developed countries. Design For Environment (DFE) is widely understood among scholars and industrial practitioners to be the integration of environmental considerations into product and process design. Design For Environment is to ensure that all relevant and ascertainable environmental considerations and constraints are integrated

into a firm's product realization (design) process [1]. Design For Environment, DEF, also known as environmentally conscious design and manufacturing or eco design, emerged as a phenomenon proposed and researched by academic scholars in the early 1990s, and has since then both in academia and industry found practitioners and proponents. In the environmental field, basic 'principles' like reduce and reuse, it could be argued that the need for health is as essential as it is important and necessary for human survival and then for development, growth and productivity as well as to enjoy life element [2, 3, 4, 5, 6].

Since the large wastes quantities can cause serious pollutants in Baghdad. These wastes are increased, compared with the year past due to the increasing population and rising standard of living resulting in increased behaviour consumer individuals which is reflected in the obstruction of the achievement of health and human development process and reflected and will reflect negatively on the economic performance and the future - the socio-economic development, [7, 8, 9, 10, 11].

The city environmental degradation was distinguished due to the anaerobic methane gases emission from landfills grounds which is considered a flammable and leads to explosion and increase the climate change impact by increasing the greenhouse gases emission GHG, (CO₂, CH₄ CO). In addition the increase of wastes can cause accumulation of salts or heavy metals was found in the landfill cover material. Efficiency gains are achieved since controlled water infiltration into the landfill body removes the need for the maintenance of airtight landfill cover integrity and the intensive degradation processes in the landfill body achieve faster waste stabilisation.

The project sought is to extent Vogel approximation of the transfer of polluted wastes and reduce the developments of this process costs. As consequences can control of wastes accumulation at the Baghdad municipal landfill sites. to mitigate the negative effects on human health.

2. Methodology

2.1. Theoretical Assumptions in the Vogel Approximation Approach

This is the most reliable method in transport models to reach the optimized solution. Equations 1-5 show transport relationship between the sources of the generated quantities transported wastes, and the locations of the landfill information to build a transport process model as follows:

2.2. Hypothesis Variable

X_{ij} represents the amount of wastes transported from the source (i) to the site (j)

Objective Function (Z): The goal of the model to reduce transport cost Minimize (Z)

$$\text{Minimize } Z = \sum_{i=1}^m \sum_{j=1}^n C_{ij} X_{ij} \quad (1)$$

where C_{ij} represents the cost of the transfer unit of the sources of production of wastes (i) to sanitary landfills (j)

2.3. Identify Constraints

$$i=1, 2, 3, \dots, m$$

$$\sum_{j=1}^n X_{ij} = a_i \quad (2)$$

$$j=1, 2, 3 \dots n$$

$$\sum_{i=1}^m X_{ij} = b_j \quad (3)$$

b_j = the quantity required at each site (j)

a_i = the quantity supplied at each source (i)

Total supply quantities a_i = Sum of the quantities required b_j.

2.4. Determining Non-negative Constraints

$$X_{ij} \geq 0 = \text{non negative restrictions}$$

Table (3) represents the public transport model, To / From destination supply quantities Supply required quantities b₁ b₂... b_j... b_n $\sum a_i = \sum b_j$

2.5. Determination of Vogel Approximate

The basic steps for a solution within the approximate method of Vogel, [12, 13, 14, 15, 16, 17] as the following:

- a) find the difference between the lowest values in each row and the lowest values in each column of the transportation costs in the transport agenda.
 - b) Identification of the highest value of the results of the above differences and called the cost of the penalty cost and identify less expensive transportation Transport cell which corresponds to the cost of the box.
 - c) The application of mathematical relationship $X_{ij} = \text{Min} (a_i, b_j)$
- where $i = 1, 2, \dots, m; j = 1, 2, \dots, n$
- d) end the row or column that has been satisfying the cell in which
 - e) The re-application of the above steps on the rest of the table cells above.
 - f) calculate the total costs of transport
 - g) determine acceptable basic primary solution that achieves limitations below:

$$\text{Quantity transferred} = \text{Quantity supplied}$$

$$\sum_{j=1}^n X_{ij} = a_i \quad (4)$$

$$\text{Quantity transferred} = \text{Quantity required}$$

$$\sum_{i=1}^m X_{ij} = b_j \quad (5)$$

In order to be a fundamental solution, every model of the transportation problem models must contain (m + n-1) of the basic variables, as

(m) represents the number of rows and

(n) represents the number of columns.

In order to reach the optimal solution, it should be all non-expanded cells evaluated (non-core variables) in order to identify the impact of these cells to function and that this goal is by following one of the ways: the way the winding path, or method of multiplication factors.

3. Results and Discussion

This new method of landfill management enables the secondary use of revitalized landfill sites improving biodiversity and increasing their public acceptance. There are numerous possibilities for the application and transferability of the approach demonstrated in Baghdad and other areas with similar climatic regimes. Top Environmental issues addressed: Themes Risk management - Site rehabilitation – Decontamination collection process and the transfer of pollutants from the important step in the process of management of wastes in the city of Baghdad, as is the secretariat of Baghdad directly responsible for the

management of wastes city centre, within the basic design of the city and that the method of management is not at the level required for the total pollutant disposal, but it is a compilation of pollutants from sources the main by the secretariat of Baghdad mechanisms and transported to the final municipal landfill sites, and through this section will be applied to the way Vogel approximate the data collected from the of Municipal Department in the city of Baghdad, in order to reduce the cost the transport of solid wastes from the areas generated to landfill sites, relying on actual data transmitted amounts of sources of supply in municipal districts to demand centres (sanitary landfills) The mechanisms used by the municipal districts represented by (trailers and the inverter WRX and the inverter press) in order to reach the lower costs of transport wastes, the following sketch shows the process of management of municipal wastes in the city of Baghdad as follows based on <http://www.mayorally-baghdad.com>. The city of Baghdad is divided into 14 municipal districts. The secretariat of Baghdad is responsible of the processes of wastes collection and disposal through its municipal districts.

Quantity supplied ai Quantity of solid wastes generated at each of the municipal districts (i = 1, 2 ,... 14). Calculation of the quantity supplied and demand and district orders required in the model of transport b in m3, and the wastes transport cost in US\$ / m3, (Table 1) as well as calculating the cost the transport of solid wastes from the assembly wastes areas to landfill and health-borne mechanisms used by the municipal districts sites, relying on hire mechanism per day and which have been identified from the secretariat of Baghdad.

Table 1. The transfer of solid pollutants different mechanisms from Baghdad to the city landfill costs.

Tool Type	Hire cost, \$/day	Wastes transferred m ³ /day	Cost, \$ /m ³
Trailers	83.33	105	0.80
Truck	75.00	42	1783
Forklift	66.67	21	3175
Presser	75.00	30	2.642

Transport by different mechanisms above costs so it will choose the less expensive of the verses, taking into account the amount transferred to the mechanism and which are described in the Table 1. The cost of transportation using trailer is the least expensive therefore be adopted to calculate the cost of the transfer of pollutants from municipal departments to landfill sites, and transportation costs per cubic meter from the municipal districts to landfill sites calculated according to the following formula:

$$\text{Transportation cost} = \text{distance (km)} * \text{transportation tariff (US\$)} \quad (6)$$

To extract the cost schedule for the model wastes transport use distances within the table above, according to extract the cost of transporting a cubic meter per formula, by multiplying of the cost per m3 above the cost of transportation using the mechanism of Cyril type reaching

the cost of transport per cubic meter per where to US\$ 0.80 / m³ was made up in the table in addition to the amounts available from the municipal districts and quantities can be processed within the landfill site (Fig. 1).

Table 2. The actual, calculated and reduced costs of wastes shipment in millions USD /year.

Actual cost, Million/year	Calculated Cost, million/year	Saved profit
14.382	8.475	5.964

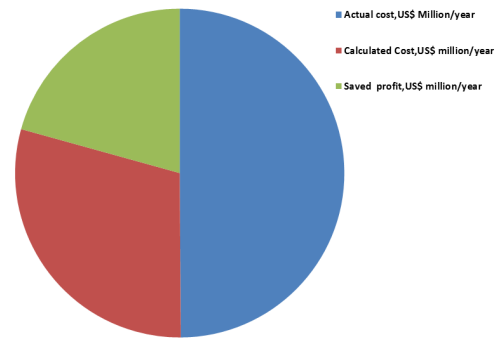


Figure 1. The actual, calculated and reduced costs of wastes shipment in millions USD /year.

Table 3. Wastes transport costs of districts orders.

order	From	To	US\$ M
1	Jawader1	Nah diala	1.350
2	Jawader2	Arika Fadel	0.925
3	Res	Sabiat	0.743
4	North Baghdad	Sabiat2	0.126
5	Aadamia	Alboatha	0.102
6	Kademia	Sabiat	0.100

Table 3. shows that the higher transport costs of wastes consisted municipality Alsadr1 to Nahdial site, which considered as the highest ranked followed by jawader2 to Arikafadel, and Rasafa to Bobalsham site. While The cost of wastes transport from New Baghdad to Sabiat, Aadamia to Aboatha and Kademia to Sabiat landfill sites are lower costs (Fig. 2).

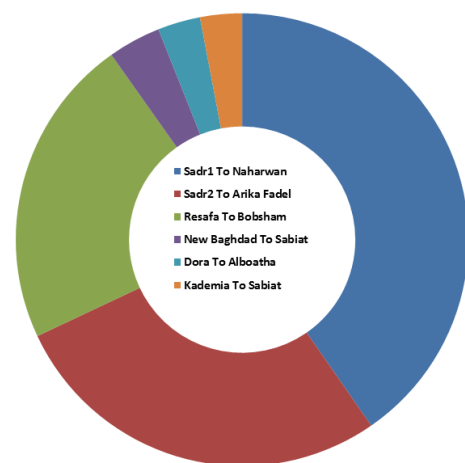


Figure 2. Wastes transport costs of districts orders.

4. Conclusions

The methodology consists in establishing dense aiming to provide efficient water protection to reduce the risk of surface and groundwater contamination from nitrogen, phosphorus, ammonia, bacteria, heavy metals and other toxic compounds.

- I. The method of Vogel approximate application can reduce the developments of this process costs which reach the abundance in costs US\$ 5.96 million.
- II. No wastes recycling due to the absence of a screening process for the types of wastes that are generated in the city of Baghdad. Recycle of 55% of the generated wastes can be utilized for re-manufactured and thus reduce the transport costs.
- III. reluctance in providing municipal services due to environmental knowledge in the iraqi educationa of citizens and led to a lack of cooperation between Iraqi society and the authorities.
- IV. spread of odors and breeding of insects and rodents proliferation Bulk animals and fires due to lack of use of practical methods in the process of loading and unloading of pollutants and for not filed periodically and regularly.
- V. The only way established by the Municipality of Baghdad in the treatment of wastes are the landfill operation, which is an open space which leads to lack sustain the environment.

Rcommendations

Expand the circle of research and development of scientific methods and techniques through the payment and to encourage researchers in this direction and applied in practice.

Create sorting plants in order to reduce pollutants transported from places generated by the landfill.

Labor contracts with experienced international companies in the field of waste management to take advantage of their expertise and the development of cadres working in this area.

Put a timetable by the municipal districts on the transfer of pollutants from places generated to the sites with an action plan that includes times of municipal mechanisms for arrival and departure and commitment

Spread environmental awareness among citizens about the importance of preserving the environment from pollution.

Encourage and push researchers about using practical methods in the field of transport of pollutants and the effects of environmental pollution and rotation of contaminants in order to reduce costs and damages from the neglect of this vital aspect of the city of Baghdad.

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