Characteristics and Compositions of Solid Waste in Baghdad

Dr.Dheyaa Wajid Abbood
Assist. professor
Al-Mustansiryiah University
College of Engineering

Dr.Ayad Sleibi Mustafa
Lecturer
Al- Anbar University
College of Engineering

Zaidun Naji Abudi
Assist. Lecturer
Al-Mustansiryiah University
College of Engineering

الخلاصة:

تم جمع وتحليل البيانات للمخلفات الصلبة للفترة من عام 1977 لغاية عام 2002 مع اختيار نماذج للمخلفات الصلبة المتولدة في (6) مناطق من بغداد شملت 1435 بيت و 28643 فرد للفترة من عام 2000 لغاية 2005. إن نمو السكان في بغداد وارتفاع مستويات المعيشة ساهمت في زيادة كمية ونوعية مختلف المخلفات المدنية المتولدة.

أوضحت الدراسة ما يأتي:

1. ازدياد المخلفات المتولدة لكل شخص في الرصافة، الكرخ من 0.32 و 0.46 كغم/يوم في عام 1977 إلى 0.98 و 1.37 كغم/يوم في عام 2002 على التوالي وفي بغداد ازدادت المخلفات المتولدة من 0.354 كغم/يوم في عام 1977 إلى 1.11 كغم/يوم في عام 2002.
2. تحتوي المخلفات المنزلية في مدينة بغداد على نسبة تراوحت بين (76-89)% من المواد العضوية والرماد ومحتوى رطوبي عالي. كما لوحظ انخفاض نسبة المواد العضوية من 91.17% في عام 1977 إلى 64% في عام 2002 في حين ازدادت قليلاً نسب مخلفات الورق، النسيج، المعادن، الخشب ومخلفات الزجاج وبشكل تدريجي ولنفس الفترة.
3. إن الكميات الحقيقية للمخلفات الصلبة هي اقل من الكميات المتوقعة والتي تم تقييمها للفترة من عام 1977 ولغاية 2002 بسبب الحروب والعقوبات الاقتصادية.

Abstract

Solid waste data survey for the period from 1977 and 2002 has been collected and analyzed, while the solid waste generated in six regions in Baghdad, which were selected and estimated to be 1435 houses and 28643 households for the period 2000-2005 was studied. The growth of Baghdad's population, increasing urbanization and rising standards of living have all contributed to an increase in both the amount and the variety of solid domestic wastes.

The amounts of waste generated and their sources, the type of materials in each waste stream, their properties, potential toxicity, and the hazards were evaluated. The lack of reliable time series on solid waste streams and rapid changes in the composition of waste streams are a serious impediment to setting priorities in solid waste management in Baghdad. The basic conclusions from this study are:-

- The waste generated per capita in Rusafa, Kerkh and Baghdad increased from 0.32, 0.46 and 0.354 kg/day in 1977 to 0.98, 1.37 and 1.11 kg/day respectively in 2002.
- Municipal wastes in Baghdad have a higher proportion of organic matter and ash, higher moisture content and lower paper content. Organic matter and ash

may account for between 76-89% of all wastes in low income settlements. The percentage of organic waste decreased from 91.17% in 1977 to 64% in 2002, while plastic, paper, textile, metal, wood and glass wastes increased slightly at the same period.

- Collected solid wastes amounts were less than evaluated solid wastes amounts during the period from 1977 to 2005 because of war and economic sanction.

Keyword: Solid Waste management, Waste composition and characteristics, Baghdad city

Introduction

Municipal wastes are composed of wastes generated by households and wastes of similar character from shops, market and offices, open areas, and treatment plant sites[1].

Many cities around the world are beginning to develop and implement "sustainability" projects. These projects typically include strategies for reducing waste, often by using waste as raw material for building homes, generating energy, or nourishing crops. Effective waste-management program must be used in Baghdad.

Sometimes researchers who study garbage find it more useful to know what waste was used for, instead of what it was made from. Waste can be put in the following product categories, food wastes (for the residual from meals), yard wastes (which are made mostly of grass clippings, but they also include dead plants and bushes, branches blown down by the wind, and even dirt, containers/Packaging that includes cans, jars, bags, bottles, boxes, and wrapping materials), containers and packaging (are form the biggest product category), and nondurable consumer goods that includes many paper products such as newspapers, magazines, and paper towels. This category also includes clothing and disposable dinner plates.

These goods are called nondurable because they are not meant to last long time-Durable consumer goods which are made of many bulky and oversized items like washing machines, old furniture, and rubber tires. The goods in this category are called durable because they are meant to last a long time.Urbanization in Baghdad has proceeded very rapidly, presenting massive challenges to future prosperity and the fight to achieve the Millennium Development Goals (MDGs). Among the problems are the sheer physical scale of growth, massive infrastructure needs, the plight of the urban poor, pollution of the environment and degradation of the coastal areas. Baghdad's total population increased from 3.0065 million in 1970 to 5.423 million in 2005.

Urban growth rates were much more rapid in the Iraq, where the urban population increased from 43% of the total in 1960, to 75% by 2005 (GEO Data Portal based on United Nations 2004)[2]. The total urban population in the region went up from 2.14 million in 1970 to 5.16 million in 2005 (GEO Data Portal based on United Nations 2005b). The urban population is currently about 21% of the total population .The concentration of population in urban areas has resulted in increased air pollution, inadequate solid waste collection and disposal, toxic and hazardous waste problems, poor or non-existent sanitation facilities and degradation of urban environments (UNEP 2003, World Bank 2005).

Methodology

Municipal solid waste (MSW) can be classified in two ways [3]:

- By Material—what the waste is made of. Waste may be plastic, paper, metal, rubber, food waste, or yard waste. A plastic toy and a plastic yogurt carton would be in the same materials category because they are both made of plastic.
- By Product—what the waste was used for originally. The waste may be an old potato chip bag, a worn-out shoe, or a broken toy. A plastic beverage container and an aluminum beverage container would be in the same product category because both are used as containers.

Reliable data on quantity and quality of wastes are important for the design of optimal collection, transportation and disposal options. Detailed field investigations were carried out to measure the quantity (waste generation rates) and quality of wastes from each category of major waste generators such as: households, restaurants, shops, hospitals, markets and street sweeping. Based on these measured values, the total quantity and the physical and chemical characteristics of combined wastes were computed. This information was supplemented with the quantity of wastes recycled by the non-formal sector - waste pickers and waste dealers. Weight is used to measure MSW because it is the most accurate measurement available. After all, the weight of the waste taken by trucks to landfills is the same as the weight of the waste buried in the landfills.

To figure out how long a landfill will be functional, however, weight doesn't matter. It is the volume of the trash that is important, not how much the trash weighs. Landfills don't close because they're overweight; they close because they have reached their volume capacity. Some waste materials can be compressed more than others. Yard and food waste, which contain a lot of water, become very

compact in a landfill. The glass bottle smashes into fine pieces, taking up less space than the plastic bottle, which squashes down but remains whole. Output analysis is based on weighing of solid waste at disposal site. A first problem in assessing waste generation is *weight* and *volum*e. The following are methods commonly used by waste collection services to estimate the total quantity of wastes collected and to be disposed of:

- Average quantity of loads collected per day multiplied by average volume/load ascertained by measuring the volume capacity of the containers or vehicles used, and converted to weight by using an average density obtained by sampling;
- Sample vehicle weightings, using a weighing bridge, the average being multiplied by the total loads/day;.
- Weighing of every load on a weighing bridge at the disposal site .Only the last method gives accurate data. However, this method is rarely a correct indication of wastes *generated*, as distinct from *collected*, because of "losses" at various stages.

Baghdad has been divided into Kerikh and Rusafa sides according to geographic site and six sections in each side have been selected to study contrary to income class. The latter approach would have the advantage that particular geographic circumstances might be taken into account. Of course, a minimum of empirical data would still be needed: the mean amount of waste per income class.

Household waste generation rate per capita in urban areas was computed in Baghdad by collecting the actual waste from households and weighing them. By this way, the losses during collection and transportation of waste were eliminated and waste generation at source was estimated.

Because of street scavengers, loss during transportation, etc. and the waste samples collected directly from households will be richer in recyclable materials compared to samples taken at disposal site.

Results

Baghdadis are producing now more waste with each passing year. Over the past 30 years, the waste produced in this country has more than five times, from 0.388 million tons in 1978 to about 2.126 million tons in 2005 [4]. Some of this increase is linked to Baghdad population growth, Fig.(1). After all, there are more Baghdadis today than there were in 1978. But that doesn’t account for the whole increase.

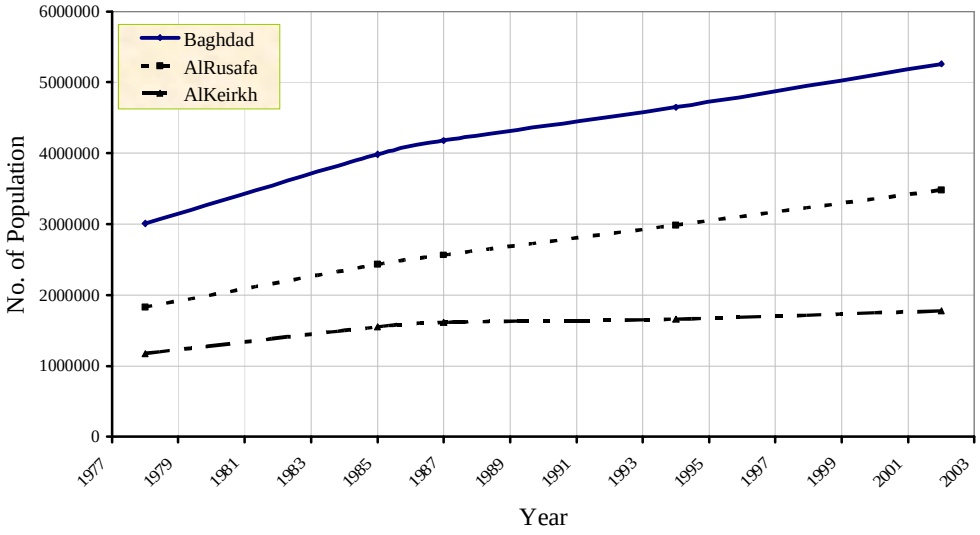


Fig.(1): Number of population in Rusafa, Keirkh and Baghdad for the period (1977-2002)[5]

Three wars and more than 10 years of sanctions caused lack in services. During mid-eighties, the solid waste generation ranged from 1.050 – 1.2350 million ton /year for various region of Baghdad city [6,7]; whereas in late nineties, it ranged from 2.03 – 2.15 million ton per year. Recent reports on waste collection, note that being a garbage collector may be one of the most dangerous jobs in Iraq. Most of the 500 municipal workers who have been killed in Baghdad since 2005 have been waste collectors. There are inadequate waste collection vehicles with only 380 presently in service. Before the invasion there were 1200 working trucks. Most of the vehicles were destroyed or lost in the looting that seized the capital after the American invasion [8,9,10]. Survey show that the actual solid waste collected is lower than the evaluated value by the governmental planning [11,12,13], Fig.(2).

Because of economic status, the generation rate in the Kerikh side is larger than that of the Rusafa side, Fig.(3). Per capita solid waste generated in Baghdad increased from 0.345kg per day in 1978 to 1.11kg per day in 2002, Fig.(3). By average weight in Baghdad, food waste account 59.6%, plastic accounts for 9.4%. Paper account for 7.9 %, metal account 6.8%, glass account 6.1%, textile account 5.9% and the rest include wood, building and garden wastes of the municipal solid waste stream in 2005

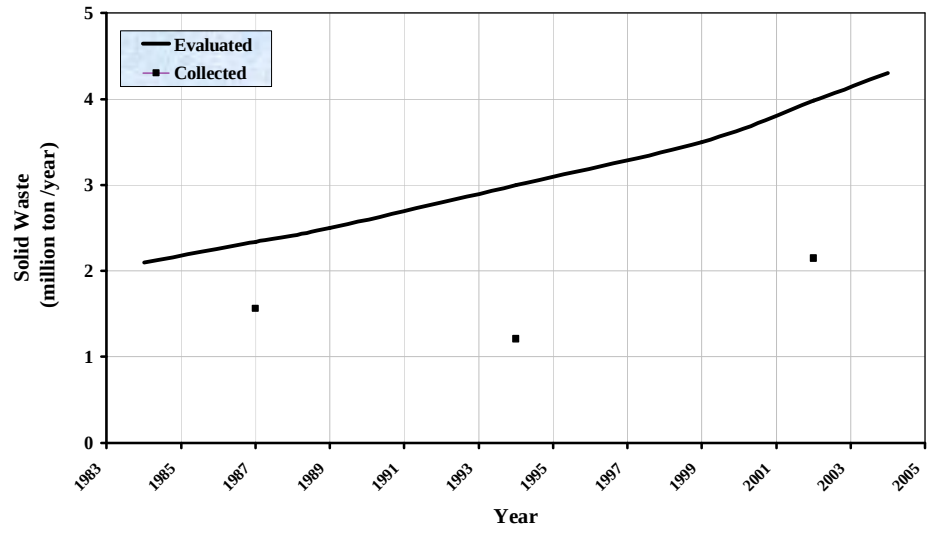


Fig.(2): Comparison between evaluated and Actually collected for the period (1984-2004)

Baghdadis are generating waste products faster than nature can break them down and using up resources faster than they can be replaced. This adds up to big trouble for the environment.

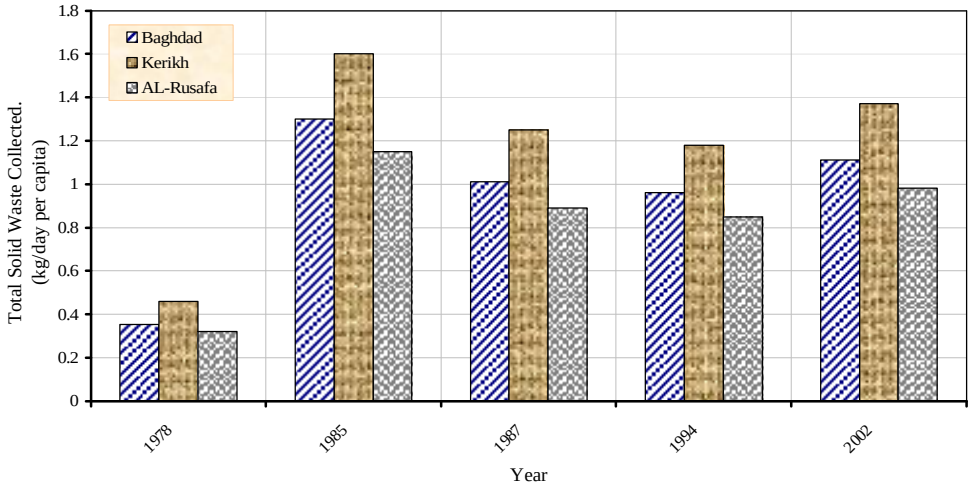
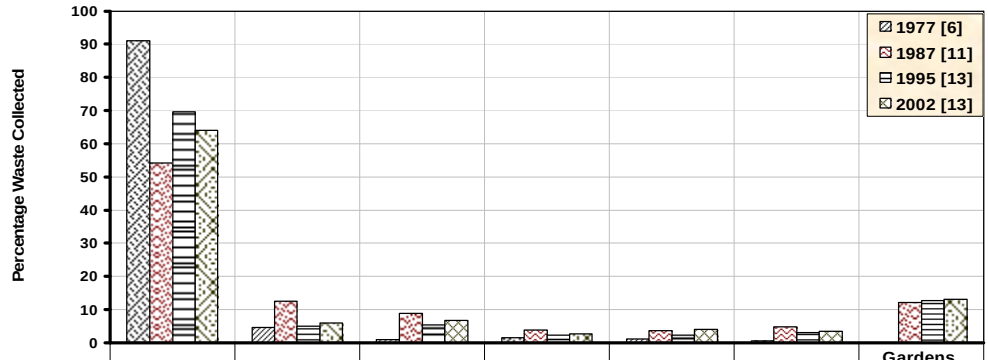


Fig.(3):Daily solid wastes generated per capita in Rusafa, Kerikh and Baghdad for the period (1978-2002)[6,11,13]

Food wastes are the large portion of the domestic waste which was recorded 91.17% in 1978 and reduced to 64% in 2002, Fig.(4).



	Food	Paper	Plastic	Glass	Metal	Textile	Gardens Waste
1977 [6]	91.17	4.53	0.96	1.59	1.12	0.63	0
1987 [11]	54.13	12.43	8.76	3.93	3.71	4.83	12.2
1995 [13]	69.6	5	5.3	2.2	2.2	3	12.7
2002 [13]	64	6	6.8	2.7	4	3.5	13

Fig.(4):Percentage waste collected of different solid waste Categories in Baghdad for the period (1977-2002)

Our lifestyle has changed, too. People are buying more convenience items and more disposables, and they choose from a wider variety of products. In 2005, the average waste generates 1.13 kg of trash every day while 0.345 kg trash per day the average waste produced in 1978. There are many factors that vary from place to place in Baghdad and that must be considered in the design of a solid waste management system. Among them are:

- Typical domestic waste from high income regions has a high content of packaging made of paper, plastic, glass and metal, and so the waste has a low density. (In other words one person can lift a typical bin when it is full). The large amount of paper and the use of preprocessed food result in low proportions of moisture in the waste. In addition, the waste may contain large amounts of moisture because of high usage of fresh fruit and vegetables.
- Another important consideration is possibility of incinerating the waste (meaning, the burning of waste under controlled conditions to minimize pollution). If the waste contains a high proportion of moisture, or is mostly inert material, it is not suitable for incineration, and so this treatment option is ruled out. Recycling or salvaging operations often reduce the proportion of combustible paper and plastic in waste before it reaches the treatment stage.

The solid waste generated in Baghdad fluctuates extremely according to the seasons and climate, Fig.(5).

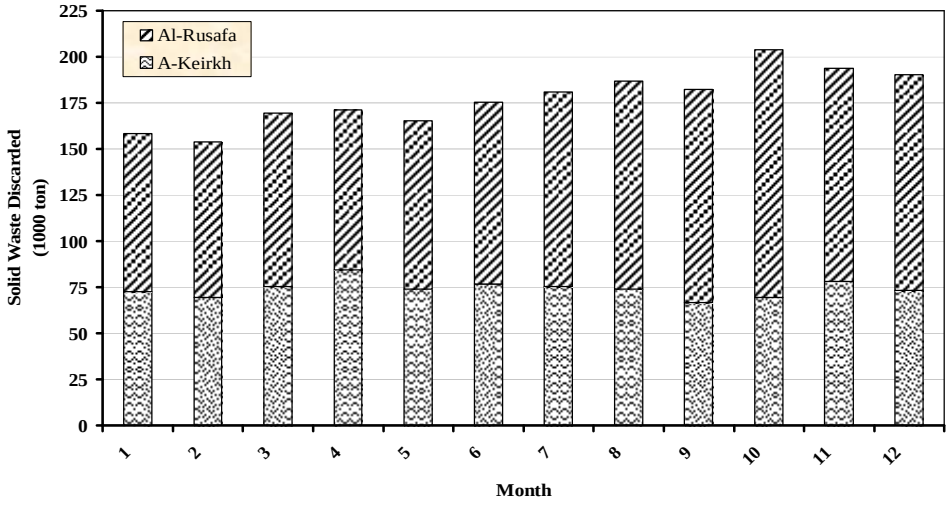


Fig.(5): The mean monthly solid wastes collected in two sides of Tigris river in Baghdad 2002[13]

Analyses for available data of waste composition over a period 1978 to 2002 in order to cover the yearly variations occur as a result of the economic statues and political condition, Figs.(6) to (9).

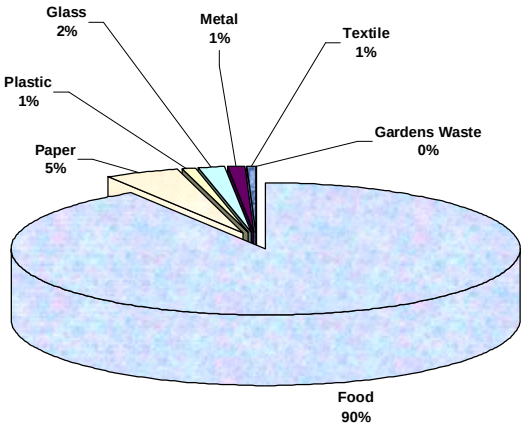


Fig.(6): Percentage solid waste by category in Baghdad 1978[6]

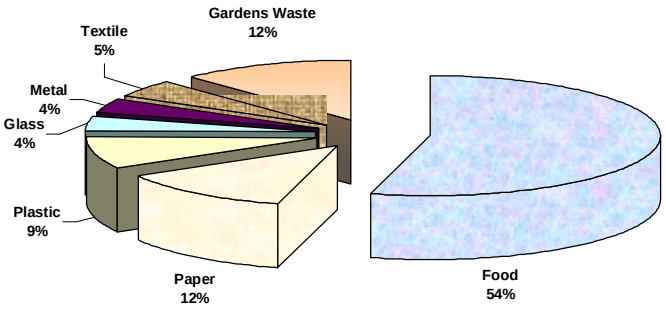


Fig.(7): Percentage solid waste by category in Baghdad 1987[11]

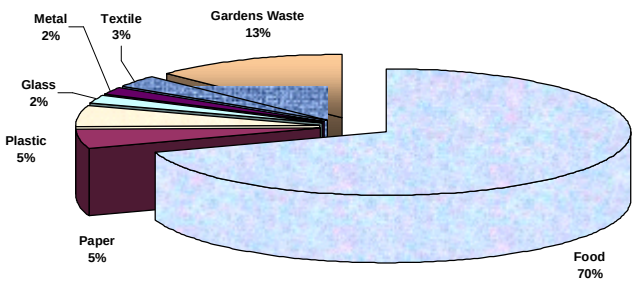


Fig.(8): Percentage solid waste by category in Baghdad 1995[13]

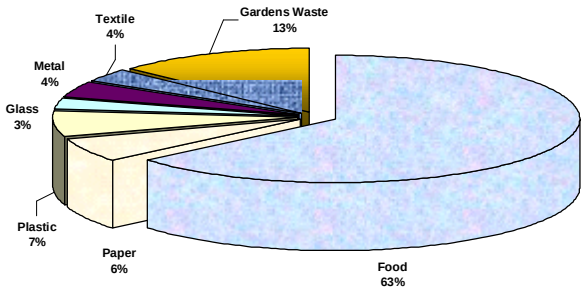


Fig.(9): Percentage solid waste by category in Baghdad 2002[13]

Analysis of physical characteristics of Baghdadian urban garbage shows that on wet basis and the moisture levels can range from 42%-69% . The wastes largely comprise of bio-degradable organics. High moisture and organic content coupled with high prevailing temperatures make frequent removals necessary. This places additional burden on already over-strained system. Incineration is not a total solution for solid wastes. The inert remains still have to be landfilled or used otherwise. This acts as a volume reduction step. In Baghdad it has not found much use as the garbage tends to be low in calorific value and volumes are generally low for a central facility. The technology for incineration is not available indigenously and import options are highly capital intensive.

The operational experience was not satisfactory. The desired calorific value garbage did not reach the facility as a result of prior segregation due to market mechanisms and scavengers. Scavengers foraging through wastes are an unhygienic practice. It still however, contributes to recycling effort in Baghdad. The scavengers act as the filter that has taken away useful materials for secondary market. The income from foraging provides much needed subsistence to poorest of the urban poor. A ban on scavenging on health grounds may seem like a solution but will only aggravate the problem of basic sustenance. Despite apparent failure of this attempt, incineration will remain an option for future and experience gained in this venture will be useful. In the meanwhile, incineration on smaller scale with or without energy recovery will continue to be a viable option in a number of locations and waste specific cases such as hospital wastes

Conclusions

The major conclusions can be summarized as follows:

1. The solid waste generated in Baghdad fluctuates extremely according to the economic status, seasons, climate and municipal services.
2. The average rate of solid waste generation in the high income families is larger more triple than low income families and the war and sanctions period changes the life styles in poor region.
3. The bad economic conditions contribute in waste reduction significantly while the scavengers recycle most of the solid waste generate without health attentions.
4. The increased rate of solid waste generated in Baghdad adds up big trouble for the environment.

5. No single technology option will be sufficient to take care of emerging problems of urban solid wastes. A mix of options will have to be developed and applied on a case to case basis.
6. With a little forethought, we could reuse or recycle more than 65% of the land filled waste, which includes valuable materials such as glass, metal, and paper. This would reduce the demand on virgin sources of these materials and eliminate potentially severe environmental problems.

References

1. Pickford John, ***"Solid Waste Problems Of Poor People In Third World Cities' In Practical Waste Management"***, Ed. J.R. Holmes, John Wiley and Sons, 1983.
2. UNEP Global Environment Outlook, Asia and the Pacific GEO Data Portal, 2004.
3. George Tchobanoglous, Frank Krieth, ***"Handbook of Solid Waste Management"***, McGraw-Hill, 2002.
4. Ministry of Environment, ***"Environmental Report in Iraq (Year 2005)"***, July, 2006.
5. Stanley, Alberta, ***"Final Report For Solid Waste Management Review"***, Prepared for the United Nations, Amant Al-Assima, City of Baghdad, Iraq, 1981.
6. Qassir, A. J., ***"Refuse Disposal Of Baghdad"***, College of Engineering, Baghdad, Iraq, 1978.
7. Amant Al-Assima, ***"Baghdad Comprehensive Transportation Study"***, Baghdad, Iraq, 1982.
8. UN Development Group Progress Report, Part 1, 11 May 2006.
9. UN Development Group Progress Report, Part 2, 11 May 2006.
10. World bank Progress report, 31 December 2005.
11. Alwan, K. H., ***"A Planning Study For The Disposal Of The Solid Wastes Generated From The Residential Dwellings, Case Study: Rusafa Side"***, A thesis, College of Urban & Regional Planning University of Baghdad, Baghdad, Iraq, 1987.
12. Ministry of planning ,***"Report Of Collection And Treatment Of Solid Wastes In Iraq"***, Baghdad, Iraq, 1985.
13. Dheyaa W., ***"Solid Waste Generated and Collected in Baghdad"***, Amanat Baghdad Consultant Study, 2002.