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Evaluation and Assessment of Generated Greenhouse Gases Produced from Collection and Disposal of Municipal Solid Wastes in Baghdad

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Abstract:
In this study, the amount of municipal waste each Iraqi produces is estimated to be 1,22 kg / day. This waste is currently being collected and transferred to designated landfills which will be buried and refilled outside the capital of Baghdad Methane gas is considered to be the second most efficient greenhouse gas after carbon dioxide, and its effect on global warming is 23 times higher than CO2. Both gasses are, however, produced extensively by the municipal waste management industry. In this study, the quantity of gas emissions from solid waste treatment is estimated in Iraq. The work relied on the protocol of the IPCC 1996 for gas generation calculation. The results have shown a huge and continually growing production of methanol from municipal waste. This is associated with the growth of the population. To do so, the adverse effects of these greenhouse gases must be promoted and implemented in the methods of using and using methane gas in electricity and heat production.
Key Words: Solid wastes, Greenhouse gases, Methanol, Iraq.

Introduction

General cleanliness is considered an essential concern for protection of the environment and health. Clean surroundings also provide a strong representation of human sociological emotions. Household waste produced must be quickly collected and disposed of, as it contains organic compounds which can decrease in production and result in insect aggregation which can contribute to disease and disease spread (1). The most popular of these gasses are Co2; Methane CH4; NO; SF6; PFC; HFC(1). There are other warming gases connected to greenhouse gasses.

Generated wastes have a global impact of around (< 5 percent) and 50 % are methane gases, which are known to be one of the main sources for greenhouse gases. Under the Global Accords, all countries should disclose and force to that as much as possible the annual volumes of their countries' gases. the It is clear that the organic content of solid waste is important (2).

Disposal of and buried waste at landfills is considered a significant contributor to the production capacity of greenhouse gasses such as methane due to anaerobic fermentation of residues, and thus solid waste collection and disposal industries. The types and amounts of solid waste produced from one country to another vary greatly from country to country (1, 3). Every individual in the developed countries generates and produces waste much more than that produced in the third world. Because of consumer preferences and disparities in quality of life.

Organic matter is higher in third-world countries than in the waste of developed countries (2). The truth is that developed countries use different variables, including materials such as paper, plastics and glass. The waste produced and manufactured from homes, hotels and other equipment and composed of glass , paper, foodstuffs and other material can be defined as municipal waste.

There are also additional industrial wastes that can be generated and found in municipal wastes, which can considered to be hazardous and need to be separated and treated specially according to their type and quantities (4). The amounts and types of generated wastes depend on many factors including: Population, living standards, environmental awareness of the society and Season of the year

Organic contents decompose to carbon and nitrogen as a result of the bacterial activity in the wastes (4,5). This process produces methanol gas and continues for years. Other volatile compounds are also produced from this decomposition activity such as non-methane volatile organic compounds (NMVOC) and CO2. The organic materials that first decompose is the sugar compounds this material is then destructed to H2 and CO2 and other acids and is converted finally to vinegar acids. The gas production from the decomposition process depends on wastes management, the composition of the wastes, the external physical conditions (Temp, ph.).

Material and Work Method.

1.2 Calculation of CH4 gases from Municipal wastes:

CH4 as estimated produced gases was calculated mathematically using the (IPCC, 1996) Equation as follows:

$$\text{Methane emissiones } \left({}^{Gy}/_{Yr}\right) = (MSW_T \times MSW_F \times MCF \times DOC_F \times F \times {}^{16}/_{12} - R) \times (I - OX)$$

Where:

MSWT Annual Produced wastes.

MSWF the solid parts of the wastes.

MCF Methanol gas correction factor.

DOC Decomposed carbon.

DOCF The actual decomposed part

F default factor (0.5)

R Gy / Yr.

OX Methane oxidize factor - default factor (0).The calculation was done in a much similar way using the tables (1, 2, 3 and 4) in IPCC (module 6 Waste IPCC 1996) as follows:

Step 1 (1 A-4):

Enter population density is Colum A table 1.

Enter amount of generated and produced wastes 1.22 kg/person per day

Multiply Colum A by Colum b and the result by 365 days and divide the results on 10 6 to convert to Ggm and then enter in Colum C.

Enter the SWDSs factor 0.80

Multiply columns D*C in Colum E

Enter the result is Colum A in table 4

Table (1) population densities in cities

MODULE	WASTE			
SUBMODULE	QUANTITY OF MSW DISPOSED OF IN SOLID WASTE DISPOSAL SITES USING COUNTRY DATA			
WORKSHEET	4-1A (SUPPLEMENTAL)			
SHEET	1 OF 1			
COUNTRY	Iraq			
A Population whose Waste goes to SWDSs (Urban or Total) (persons)	B MSW Generation Rate (kg/capita/day)	C Annual Amount of MSW Generated (Gg MSW)	D Fraction of MSW Disposed to SWDSs (Urban or Total)	E Total Annual MSW Disposed to SWDSs (Gg MSW)
*	**	C = (A x B x 365) /106	***	E = (C x D)

7092624	1.22	3158.34	0.8	2526.67

Table (2) Estimated factors

SUBMODULE	DISPOSAL SITES USING DISPOSAL RATE DEFAULT DATA	
WORKSHEET	4 -1B (SUPPLEMENTAL)	
SHEET	1 OF 1	
COUNTRY	Iraq	
A Population whose Waste goes to SWDSs (Urban or Total) (persons)	B MSW Disposal Rate to SWDSs (kg/capita/day)	C Total Annual MSW Disposed to SWDSs (Gg MSW)
*	**	C = (A x B x 365)/1 000 000
7092624	1.22	3158.34

Step two (1C-4):
Determining the wastes weights (SWDSs)
Entering the methanol correction factor.
Multiply Colum X with Colum W and enter the result in Colum Y
Addition of values of Colum Y and getting the average methanol production SWDSs with MCF=0.74
Enter result in Colum B of table 4.

Table (3) Methanol correction factor

MODULE		WASTE	
SUBMODULE		METHANE CORRECTION FACTOR	
WORKSHEET		4 -1C (SUPPLEMENTAL)	
SHEET		1 OF 1	
COUNTRY		Iraq	
Type of Site	W Proportion of Waste (by weight) for Each Type of SWDSs	X Methane Correction Factor (MCF)	Y Weighted Average MCF for Each Type of SWDS
			Y = W × X
Managed	0.38	1.0	0.38
Unmanaged - deep (>=5m waste)	0.29	0.8	0.23
Unmanaged - shallow (< 5m waste)	0.33	0.4	0.13
Total	1	0.6	0.74

Step Three (1-4):

Organic carbon is estimated (DOC=0.21) for wastes of SWDSs from the (IPCC). The closest country to Iraq available in the table is Egypt. The values is then placed in column C of table (6).

The actual organic carbon value of (DOC-0.77) for wastes SWDSs from (IPCC) is then entered in column D.
The released carbon part as methanol gas is entered (0.5) for wastes SWDSs from (IPCC) and placed in column E.
The released CH4 from wastes is found by multiplying column C *D*E with conversion factor 16L12 to convert to methanol gas and then the value is entered in column G.
The released CH4 is then calculated by multiplying columns G*B and then entered in column H.
Step Four (1-4)
The total annual produced and relased CH4 is found by multiplying columns (H*A) and placed in column J.
The returned CH4 amounts and placed in column K.
The net CH4 made annually is found by subtraction column K from Column J and then the value is entered to column L
In column M the methanol correction value is entered.
Column L is multiplied by Column M and the result of clear CH4 gas is entered in column
The result in column N is the calculated net CH4 produced.

Table (4) CH4 produced from Solid wastes

MODULE	WASTE									
SUB MODULE	METHANE EMISSIONS FROM SOLID WASTE DISPOSAL SITES									
WORK SHEET	4-1									
STEP 1	STEP 2	STEP 3						STEP 4		
A Total Annual MSW Disposed to SWDSs (Gg MSW)	B Methane Correction Factor (MCF)	C Fraction of DOC in MSW	D Fraction of DOC which Actually Degrades	E Fraction of Carbon Released as Methane	F Conversion Ratio	G Potential Methane Generation Rate per Unit of Waste (Gg CH4/Gg MSW)	H Realized (Country-specific) Methane Generation Rate per Unit of Waste (Gg CH4/ Gg MSW)	J Gross Annual Methane Generation (Gg CH4)	K Recovered Methane per Year (Gg CH4)	L Net Annual Methane Generation (Gg CH4)
*	**	***	****	*****	******	G= (C x D x E x F)	H= (B x G)	J= (H x A)	******	L= (J - K)
2526.67	0.74	0.21	0.77	0.5	16/12	0.11	0.0814	205.6709	0	205.67

Relative Humidity
The materials used are sensitive weight, drying oven, and accessories such as nylon bags and gloves. The work is then done in stages (5):
1st – Sampling stage by taking 1 kg of sample to the lab.
2nd – Estimating the inertial humidity. By weighing 1/2 kg of the sample before and after drying
First sample -130 gm
Second sample 178.23 gm
Them placing the samples in a drying oven at 700 CO for 24 hours and left to cool in isolation from air and then weight again to find the weight difference .
3rd – Finding second humidity value. The samples are returned to drying oven at 1500 Co for 3 hours and left to cool for 30 min and reweight to find the difference between the weights.
4th – finding Total humidity.

Total humidity % = inertial humidity % + Second humidity %

Density

Density calculation is carried our by taking samples and placing them in a 14 litter pot and applying the below equation (5, 3).

$$\text{Density} = \frac{P_1 - P_2}{v}$$

Were:

P1: weight of filled pot kg

P2 Weight of empty pot kg

V: pot volume m3

Results and Discussion:

Around 2000 questionnaire forms were distributed in different places in Baghdad. The form consisted of information related to the size of the family and the estimated generated wastes from households as seen in appendix (1). Approximately 1800 forms were revived back filled with the required data and 165 of the forms were excluded as they did not match the questionnaires design. The average estimated waste for each Baghdadi individual was then calculated and was found to be highest at (1.62 Kg/day) at ZAYONA district and as low as (0.7 Kg/day) at ALMADAIN . Figure (1) and appendixes (2) and (3) show the individual wastes variations and calculation in different parts of the city.

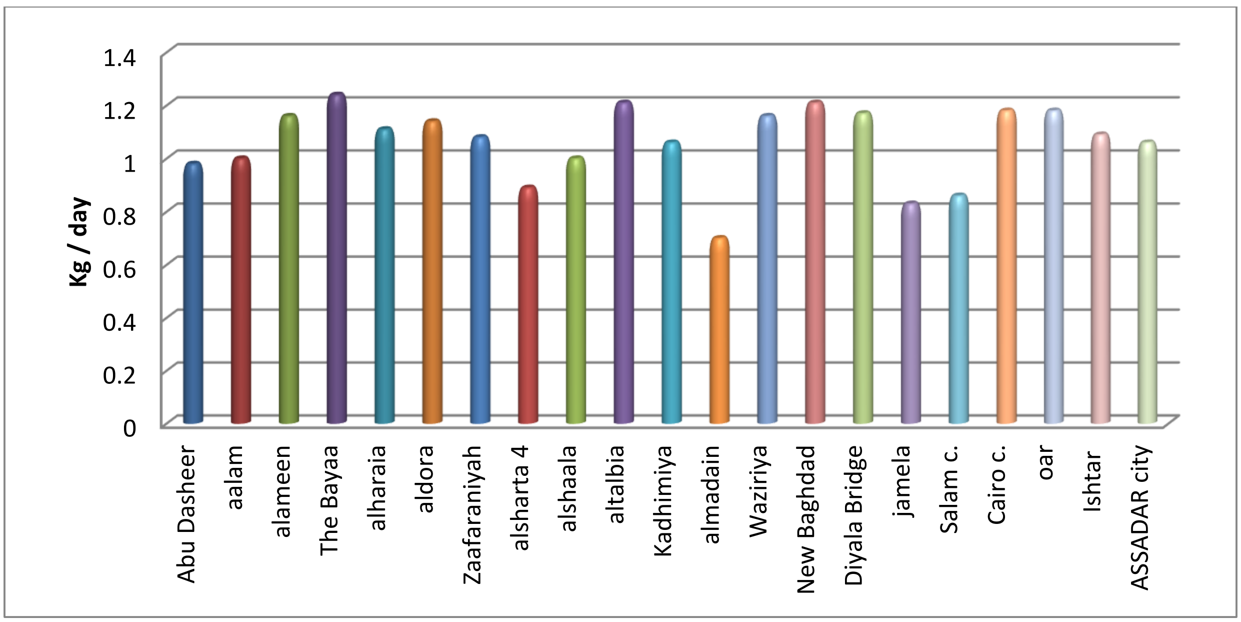


Figure (1) average Waste generation Kg / per individual per day at different parts of the Baghdad

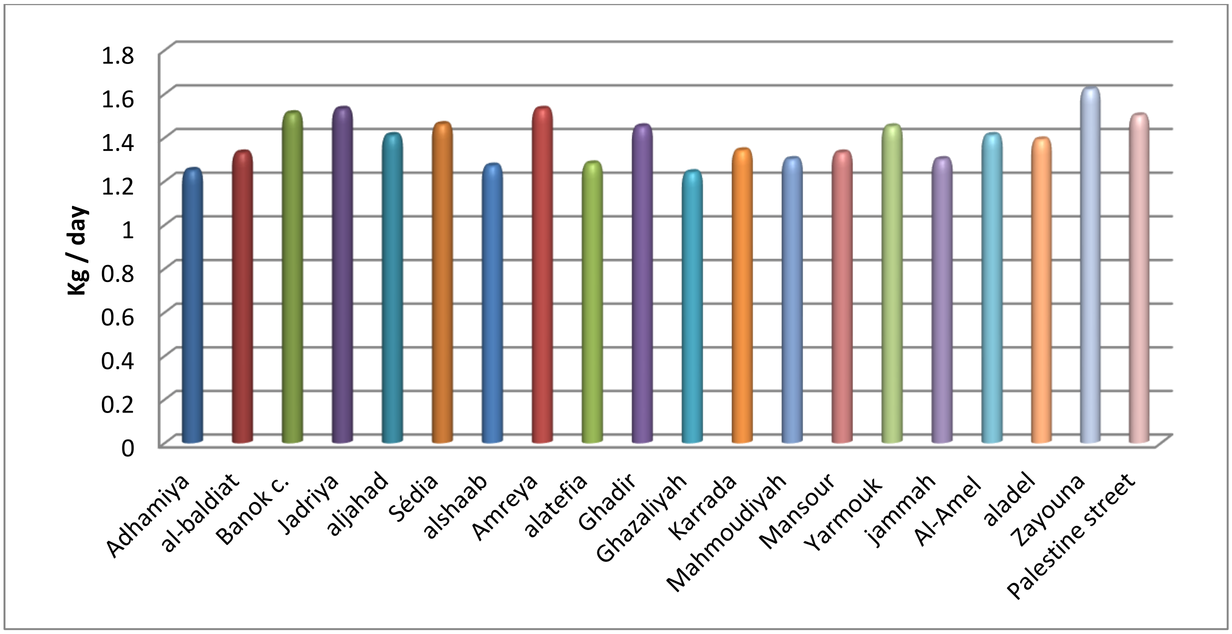


Figure (2) average Waste generation Kg/ per individual per day at different parts of the Baghdad

The next step was taken by calculating the average Iraqi individual waste production quantity per day and it was found to be of (1.22 kg/day). This value was compared with other values of other individual's waste production in other parts of the world as seen in figure (3). The value is considered reasonable with other values optioned in nearby countries.

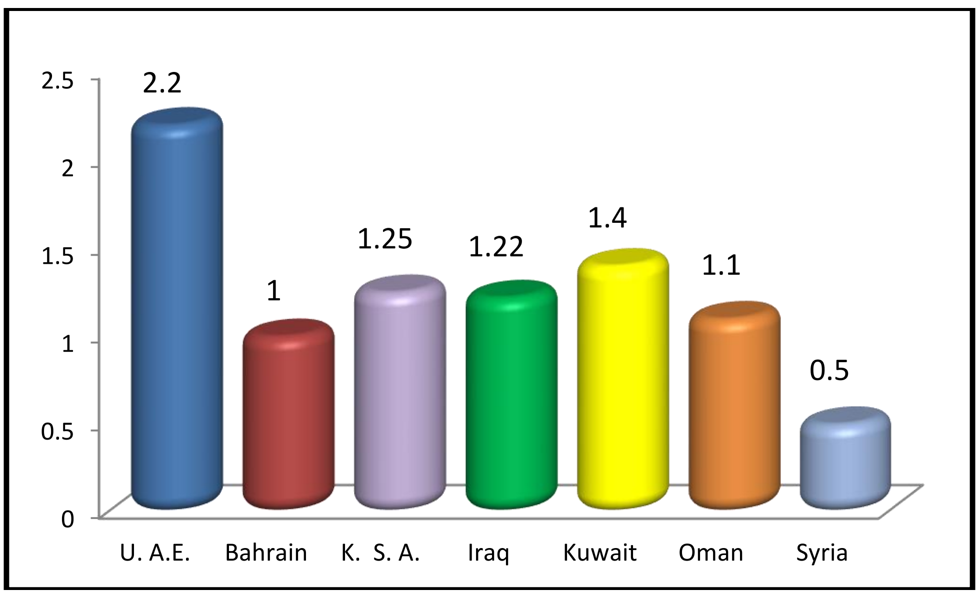


Figure (3) Estimated waste generation for each individual in different countries

Iraq's population is considered to be (30,680,190) person {Iraq environmental survey, 2010}. Meanwhile Baghdad population in respect to the ministry of planning data for 2010 is (7092624) person. After following the steps for methanol gas production calculation from waste as stated in (Module 6 waste) and as shown in figure (4), the methane gas production in Baghdad was found to be (205, 67 g) .The high gas production and high waste generation is related to the respectively high living standards and life style of the people in Baghdad city. This comes compatible with other studies that relate to gas production and waste generation to living quality and standards , as this value has been recorded to be (9,293) in Swiss land and (8,381) in Norway . The lower this value the lower the economy of the country (147 in ozbakstan, 334 in magnolia and 338 in ocarina).

The relative humidity measurements from the waste samples were relatively high. The average humidity value was between (54, 02 %) and (43, 89 %) with an average value of (48, 95 %) as shown in figure (5). Waste density was between (0.107 Ton/M3) and (0.321 Ton/M3) with an average value of (0.212 Ton / M3) as shown in table (6).

Table (5) Relative humidity measurements of wastes

Factor	Sample No. 2	Sample No. 1
Weight of sample taken (g)	178.23	130
The weight of the sample after drying g. 700 m (g)	105.74	67.3
Difference (primary humidity) (g)	72.49	62.7
inertial humidity%	40.67	48.23
The weight of the sample after drying is 1050g (g)	109.15	71.2
The difference between drying at 700m and 1050m (secondary humidity) (g)	3.41	3.9
Second humidity%	3.22	5.79
Total humidity%	43.89	54.02

Table (6) Density Values

Sample No.	Weight (kg)	Density of ton / m 3
1	4.5	0.321
2	3	0.214
3	2.5	0.178
4	2	0.142
5	3.5	0.25
6	4	0.285
7	1.5	0.107

Conclusion and Recommendation.

Living standard has a big effect on individual waste generation.

Iraqi wastes have a relatively high organic content compared with others.

Organic wastes produced from houses should be separated from the rest of the wastes. Waste separation has many positive effects and reduces the impacts on the environment.

New methods for utilizing produced methanol gases from wastes should be developed. This will reduce the negative impacts on the environment and also has positive economical returns.

Waste management guidelines and training programs should be encouraged.

Educational materials especially for school students related to better management and handling of wastes should be made to raise environmental awarance.

References

Frikha, Y., Fellner, J. and Zairi, M. (2017). “Leachate Generation from Landfill in a Semi-arid Climate: A Qualitative and Quantitative Study from Sousse, Tunisia.” Waste Management & Research 35: 940-8.

Ali Chabuk1, 2, Nadhir Al-Ansari1 , Jan Laue1 , Karwan Alkaradaghi1, 3, Hussain Musa Hussain4, 5 and Sven Knutsson (2018), Application of the HELP Model for Landfill Design in Arid , Journal of Civil Engineering

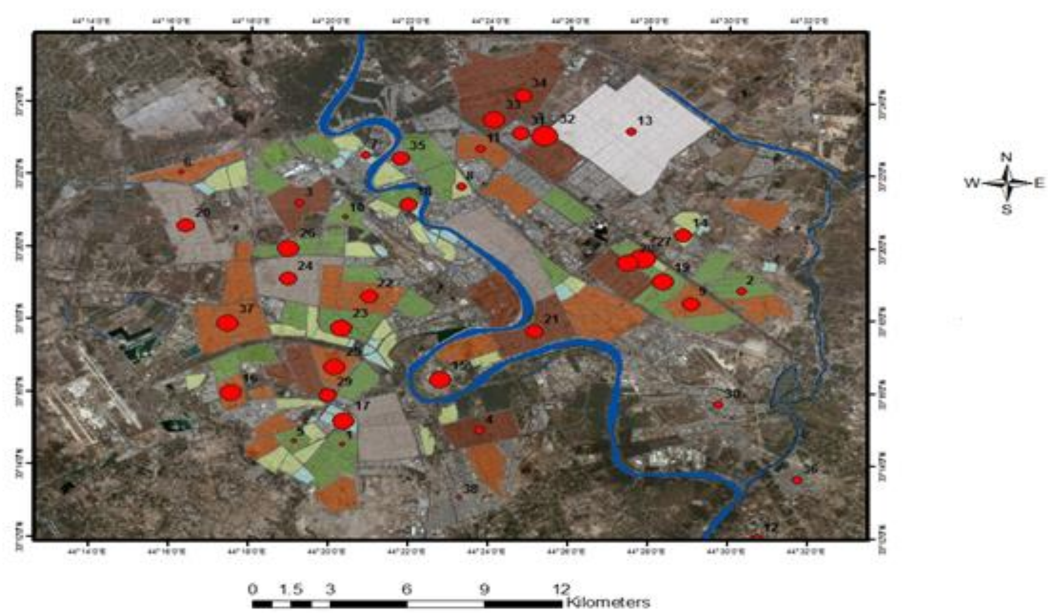
and Architecture 12 (2018) 848-879 doi: 10.17265/1934-7359/2018.12.003.
Iraqi Ministry of Transportation Constitutions. 2017. Iraqi Meteorological Organization & Seismology. Internal Reports, Iraqi Ministry of Transportation constitutions, Baghdad, Iraq.
Adriana Gómez-Sanabria, Lena Höglund-Isaksson, Peter Rafaj, and Wolfgang Schöpp (2018), Carbon in global waste and wastewater flows – its potential as energy source under alternative future waste management regimes , Adv. Geosci., 45, 105–113, 2018 https://doi.org/10.5194/adgeo-45-105-2018.
UNFCCC: National Inventory Submissions 2016, available at: https://unfccc.int/process/transparency-and-reporting/reportingand-review-under-the-convention/greenhouse-gasinventories/submissions-of-annual-greenhouse-gas-inventoriesfor-2017/submissions-of-annual-ghg-inventories-2016 (retrieved 2017), 2016.
Revised 1996 IPCC Guidelines for National Greenhouse Inventories, vol. 1-5, NGGIP, IGES, Japan. (http://www.ipcc-nggip.iges. or.jp)

Appendix:

Appendix (1) shows the questionnaire form

No. of family						note	
home address							
Family monthly income level	More than 1,000,000		400,000 to 1,000,000		100 thousand to 400		
Approximate amount of waste disposal	>15Kg/day		10Kg/day		5Kg/day		
rate of passing of the switches	daily		weekly				
Is the waste separated by the consumer?	yes		no				

Appendix (2) shows per capita consumption per kg / day according to residential neighborhoods of Baghdad city



Appendix (3) shows per capita consumption per kg / day according to residential neighborhoods of Baghdad city