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Electric Generation with Valuation Method for National Methane Revial from Domestic Waste Sanitary Land

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Abstract: In recent years, the economic and social developments in addition to the expansion of various activities in the main cities have led to the emergence of new patterns and practices that have led to the increase in human requirements. Consequently, this led to the production of large quantities of waste which highly contributed to the environmental pollution. One of these waste products is biogas. The biogas generated from the decay of organic waste with absence oxegen in the sanitary areas is the principle constituent of the biogas in the methane gas. Currently, there is growing interest in using landf ill gas to produce energy. In this study, the problem of waste accumulated in some Iraqi cities is overcome by converting it into electrical energy to plug the needed part of total energy and compensate it for the grid, the methane quantities of the waste was calculated by estimation method in three Iraqi cities (Mosul/Bagdad/Kirkuk) to use it in generating electric energy.

Key words: Electric generation by methane, valuation method, biomass, sanitary land, Iraqi cities, production

INTRODUCTION

Methane valuation from sanitary land is estimated between 3-19% from sources in the world. The valuation can be get by using national statistics data of waste production. In some countries, essentially the development countries, the data was collect about waste production is not sincere and that cause to mistakes in the accounts. In this study, therefore, it makes an endeavor to calculate the datune values of methane revial from Municipal Solid Waste (MSW) sanitary land by carrying out perfect exploration both from field and collected data that already exists (Themelis and Ulloa, 2007; Kumar *et al*., 2004).

There is no big difference in some countries around the world between housed waste and coal, both of them are capable of generating electricity. Many countries including Iraq have not yet tried to take advantage of waste and move towards producing clean energy based on purely domestic resources. The exploitation of waste in this way adds great value to the economy and local production as it reduces the import of electric power from neighboring countries relying on the bioenergy of electricity production for house installations, factories, etc., on the other hand, the makeover is towards self-sufficiency. The burning of methane extracted from landfills prevents the emission of carbon gases that causes global warming, methane gas from unhealthy landfilling can have severe environment damage and is 25 times more harmful than CO_2 (AL-Rifaie *et al*., 2018; Robb, 2006).

MATERIALS AND METHODS

CH_4 emission in year: Several methods exist and are globally followed to estimate the amount of methane emitted from landfills. The selection of method depends on several variables, the same as slow decay coefficient, fast decay coefficient, time of decay and temperature but largely followed by the main two methods (default method and First Order Decay (FOD) method). In this study we use the default method which depends on several variables (Ofoefule and Uzodinma, 2005; Uzodinma *et al*., 2007). The equation which calculates the methane emissions in (Gg year^{-1}) is:

$$= (MSW_T\_MSW_F)\times lo)\text{-}R\times(1\text{-}OX)$$

$$lo = (MCF\times DOC\times DOC_F\times F\times 16/12)$$

Where:

1 Gg yr^{-1} = 1000 tones year^{-1}
MSWT = Total MSW population (in thousands-year)
MSW = Production rate (Gg person by thousands/year)
MSW_F = Fraction of domestic solid waste reject of to the disposal sites

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The ration of 70% depend on field exploration studies. The residual 30% that recover by recycling firing at source, sanitary land due to in atlention domestic waste management system. MCF = Methane correction factor (ratio), ratio based on the method of disposal and the deep of sanitary land. The IPCC document indicates the value of 0.4 from Table 1. DOC = molder organic carbon (ratio). DOC content is substantion in caculation of methane production. It based on differences in composition of organic waste from place to place. Equation to determine DOC values:

$$0.4A \quad 0.17B \quad 0.15C \quad 0.3D$$

Where:
A = Paper+rag
B = Leaves+grass+straw
C = Fruits and greenery
D = Timber

DOC_F = Ratio of DOC dissimilated. The model is represents as 0.014T+0.28, where T = Temperature in °C. The temperature residual constant at 35°C in the anaerobic zone of the sanitary land. The value is subsequently computed as 0.77 and adopted:

F = Fraction of methane in LFG (default is 0.5)
R = Recovered methane (Gg year^{-1})
OX = Oxidation factor (default is 0)

It is for the methane that is oxidized with oxegen in high layer of solidwaste. The oxidize lessening from the production of ethane as zero (Richard, 2005).

Table 1: The IPCC document

Type of land	MCF
Sanitary	1.0
Un sanitary-deep (≤5 m solids)	0.8
Un sanitary-shallow (<5 m solids)	0.4
Open dump	0.6

Study area: In this research, three Iraqi cities were selected to find an amount of methane emitted from the land fill area and its use to generate electricity, these areas are Mosul, Kirkuk and Baghdad. Figure 1 shows the study areas.

Baghdad city: Baghdad is the capital of Iraq and the center of the province of Baghdad, the largest city of Iraq, in terms of population and has a population of about (7, 878, 087) person with an estimated population growth rate of 2.78%, the rate of solid waste production (0.8 kg/person/day). Thus, the amount of total solid waste in the city of Baghdad is equal to 2,300,401 ton/year, solid waste is treated by indiscriminate firing in the Abu-Ghraib Area.

Mosul city: The city of Mosul is the center of Nineveh Province, the second largest city in Iraq in terms of population and the number of people about 1,598,000 and growth rate of 3%. The solid waste production rate is 0.8 kg/person/day bringing the total solid waste to this city 466,616 ton/year. In this city waste is treated by in discriminating firing in the Al-Sahaji Area which is far from the city center and in Kukjali Region.

Kirkuk city: The city of Kirkuk is the center of Kirkuk Governorate and fifth largest city of Iraq in terms of the number of population of about (999,062) a population and growth rate of 3%, the solid waste production rate is 0.85 kg/person/day and thus the amount of total solid waste in the city of Kirkuk 309,958.986 ton/year.

Waste is treated by the land fill method according to the scientific specifications and environmental determinants. It is located in Zandana Area which is 25 km from the center of the city and an area of 240 acres.

Fig. 1: Study area

Table 2: The real value of the land fill

Cities study	MSWTG g/year	MSWF (%)	A	B	C	D	DOC	Lo	t (Gg/year)	t (m^3/year)
Baghdad	2300.4	10	1.838+10.179	2.034	55.321	0.483	13.6	4.19	963.868	963868.18
Mosul	466.616	55	2.062+6.68	2.624	76.688	4.841	16.9	5.2	1334.5	1334504.6
Kirkuk	309.959	75	0.15	0.06	0.42	0.03	0.1422	0.07299	16.969	16969

Table 3: Assuming the MSWF value became 100%, the result is shown in Table3

Cities study	MSWTG g/year	MSWF (%)	A	B	C	D	DOC	Lo	t (Gg/year)	t (m^3/year)
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Mosul	466.616	100	2.062+6.68	2.624	76.688	4.841	16.9	5.2	2426.37	2426372
Kirkuk	309.959	100	0.15	0.06	0.42	0.03	0.1422	0.07299	22.625	22625

There are two main stations, the first one is in the area of 1 Athar and away from the center of the city by 18 km. and land fill site 18 km and the second is located on the road to Sulaymaniyah Kirkuk and away from the city center by 17 km. and the site of land fill 34 km (Table 2 and 3).

The percentages of the types of waste collected were obtained for all kinds of land fill in addition to the weight of household waste (Directorate of the Municipality of Kirkuk Statistics Department).

RESULTS AND DISCUSSION

According to our data, the default method to estimating the amount of methane which is generated in the land fill area has been adopted and we obtained the results shown in Table 2. Pursuant to global research in this area the rate of electricity production per 1 m^3 of methane generates 1.25 kw as an external power.

In Table 2 and 3, we notice that there is a significant difference in the values of A,B and C between the city of Kirkuk on the one hand and the cities of Baghdad and Mosul on the other hand. The reason behind this is that the city of Kirkuk contains a sanitary landfill built according to international specifications. Wastes (A-D) are recycled if compared with Baghdad and Mosul where there is no recycling of wastes because it is just a random garbage throwing.

The required electricity power rate for Iraq is 16000 MW/day while the total supplied power of the National Grid is 10000-12000 MW/day and therefore, we have a deficit of 4000-6000 MW/day. But if we connect the methane stations to the National Grid by 82% of the deficit will be covered as shown in Table 4.

Table 4 shows the production of electric power generated from methane according to the real values of the land fill with the population. Table 5 hows the values of power generated by the methane stations for the study areas when they are connected to the national grid by which the deficit is covered by 100% in addition to a surplus of 57% in supplied power.

Table 5 shows the values of electricity generated from methane, if the amount waste reaching the land fill site is 100% with the population benefiting from the energy generated.

Table 4: Production of electric power generated from methane

City area	MSWF (%)	Power (p) MW
Baghdad	10	1204
Mosul	55	1668
Kirkuk	75	21.211

Table 5: Values of power generated by the methane

City area	MSWF (%)	Power (p) MW
Baghdad	100	12048
Mosul	100	3032
Kirkuk	100	28.281

CONCLUSION

In this research, the generation of methane from the landfill area was studied using the virtual method in three Iraqi governorates (Baghdad, Mosul and Kirkuk) and the possibility of using it to generate electricity in addition to linking the methane stations to the main grid. The results revealed that the 82% shortage in power can be covered if all garbage is delivered to the landfill site. In this case, the deficit will be covered by 100%, plus a surplus of 57% in supplied power that can be exported to other countries.

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