

## Utilization of Bio-Solid Waste to Partially Tackle Electric Power Shortage in the Gaza Strip

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**ABSTRACT:** Bio-solid waste is one of the most important sources of alternative energy worldwide. However, in the Gaza Strip, Bio-solid waste and Bio-solid waste in particular is considered as a substantial environmental and financial problem. This includes the problem of contaminated gas emissions and toxic substances leaking from Bio-solid waste. The financial costs of waste management pose another problem including the cost of waste collection, transfer and burn. Such problems are caused by not following the right and professional methods in waste collection, sorting and recycling

Given that Bio-solid waste production in the Gaza Strip is very high (60-70% of total bio-waste) [1], this study considers solutions to the environmental and financial issues related to Bio-solid waste management in the Gaza Strip. It is very important to raise the awareness of individuals in dealing with such waste in the most efficient way. This involves all the stages of waste management starting at proper sorting up to the full exploitation of all waste processing outcomes. This includes exploiting gas emissions in cooking or burning it to generate electricity. In addition, Methane gas generated from the deposits of bio-waste is considered as one of the best fertilizers in agriculture.

**KEYWORDS:** Bio gas, Bio mass, Bio-solid waste, Solid waste.

### I. INTRODUCTION

Although most of the Bio-solid waste in Gaza strip is Bio-solid waste easy to sort and recycle, the amounts of which are actually recycled do not exceed 2% [2].

Bio-solid waste administration in Gaza strip lacks the proper strategy which can allow recycling up to 20% of waste by the end of the current decade, for example.

This amount can be increased to 40% by 2025 and then it can reach 50% [2]. This can be a decisive solution to the dangerous health, environmental and economical problems (harms) resulting from the widespread random waste deposits in addition to the limited ability to provide site for the minor waste deposits present now, as well the dangerous lack in areas necessary for burying Bio-solid waste. Currently, most of the waste is buried in random unhealthy deposit.

Even founding two or three deposits will not be able to contain all produced waste, since within 3 to 5 years expected that a big amount of extra waste will be accumulated. This extra amount constitutes 50% over the capacity of the present or planed deposits.

Foot waste is not supposed to be harmful to human health or environment. For a long time a lot of countries all over the world have been recycling waste in order to generate electricity. On the Palestinian level, as we depend on Israel to provide us with all forms of energy, most of our waste end, in deposits.

Therefore, we have to put suitable plans to encourage generating clean electricity from Bio-solid waste. This will enable us to depend on our self-produced electricity.

Even on the easier (simpler) Palestinian level, particularly recycling Bio-solid waste into organic fertilizers the prospects are not encouraging.

The high level of Bio-solid waste, originally organic, which ranges from 60 to 70% of the total amount of Bio-solid waste [1], is supposed to make the projects of manufacturing organic fertilizers a basic means of reducing the amounts of Bio-solid waste. This manufacturing process is supposed to highly increase the recycling level since compost manufacturing requires and simple cheap (unsophisticated) technology which is still marginal on the Palestinian level [2].

### II. STUDY OBJECTIVE

- To benefit from the vital gas (Methane) resulting from bacteria decomposition into Bio-solid waste and to transfer it into electric energy or using it as an alternative to cooking gas.
- To benefit from Bio-solid waste by turning it into organic fertilizers which can be used in agriculture?
- To guide and encourage citizens to deal with this waste in a correct and useful way mainly by recycling.

### III. STUDY METHODOLOGY

#### 3.1. Gaza population and the amounts of Bio-solid waste produced in Gaza Strip

According to the civil registry of the Interior Ministry the population of Gaza in 2012 scored 1.79 Million [10].

According to the Palestinian central Bureau of statistics, domestic environment survey, the amounts of solid waste produced reached 2350 tons a day in all Gaza Strip governorates [3].

#### 3.2. The means of collecting Bio-solid waste in Gaza strip

There are three ways (means) of collecting Bio-solid waste in Gaza strip:

- Bio- solid waste is put into tightly sealed bags (containers) to be moved later by larger containers to the recycling sites.
- Bio-solid waste is sorted and separated manually or mechanically.
- Founding waste deposits in various areas on lots of land, bought for reasonable price. This can be achieved through raising the awareness of individuals of the importance of using Bio-solid waste in producing the vital gas and organic fertilizers.

#### 3.3. Kinds of solid waste and the amounts produced

It's well-known that solid waste is one of the most polluting things. This is quite clear in Gaza because of the bad administration as a result of lack of facilities and the areas allotted.

Table 1. This table is showing the kinds of solid waste in Gaza strip, the percentage of each kind, and the daily amount in tons [3] [4].

Kind of solid waste	%	Solid Waste in Tons
Bio- solid waste	65%	1527.5
Plastics	8%	188
Paper and paperboard	8%	188
Glass	6%	141
Total metals	8%	188
other	5%	117.5
	100%	2350

### IV. BENEFITING FROM BIO-SOLID WASTE IN GAZA STRIP

The huge amount of Bio-solid waste produced 60% - 70% as a product of solid waste has made researchers specialized and more interested in this field, so they started to look for better ways to use it [1].

The following are some suggested ways to use this waste:

#### 4.1. Producing the vital gas (methane) from Bio-solid waste

It is not something new to produce the vital gas (methane) from Bio-solid waste. This even one of the oldest (earliest) ways of producing energy in many countries like (India, China, Germany., ect.), but what is new is how to make the utmost use of this vital gas which reaches a purity of 70%.

Methane can be produced from Bio-solid waste such as the remains of vegetables, meat and food by a method called "digestion". This can be done by putting the animal waste in a container called the "digester" in which no access of oxygen is allowed. The bacteria decompose the waste in the absence of oxygen and thus methane is produced as well as other carbon oxides. Then the gas resulting from waste composition is collected and burnt.

#### 4.2. Producing organic fertilizers from Bio-solid waste

This is a biological process in which Bio-solid waste, with the help of present micro organisms (bacteria) found in the air, to black solid rich in minerals in order to fortify land with nutritive elements, which helps in land fertility.

Organic fertilizers are divided into two ways regarding their production:

1- This fertilizer can be extracted from vital gas producing stations after gas production process. This gas can be emptied as a relatively liquid material and pumped into solid by special pumps. Sediments can be extracted, dried, ground and sprayed on the solid as powder.

2- Collecting various Bio-solid waste and putting it in closed places whose temperature 25 – 37 degree Celsius is suitable for bacteria activity [6].

This waste is left intact for 4 – 5 months until it becomes rich in minerals necessary for plants [7].

N.B.: This fertilizer is considered the best since it is natural and void of any industrial ingredients, which makes it suitable in the absence or scarcity of moisture or in high temperatures.

**4.3. Burning all kinds of Solid waste**

This disposal of solid waste by collecting and burning is divided into two ways:

1- Solid waste is usually collected in big container, and transported by trucks to places relatively far away from inhabited areas, and then it is burnt without regarding law or environment constraints. This causes serious damages to the environment and cultivated areas owing to emission of polluting gases.

Unfortunately, this method is being followed in many places all over the world including Gaza Strip.

2- Waste is burnt in furnaces designed for this purpose to make the utmost use of the produced (heat) in heating water and using it for generating electricity by means of turbines, In this case we can control the emission of pollutants by means of treatment.

**4.4. Burying Solid waste under the ground**

This is the most friendly ways to the environment if it is carried out professionally, otherwise, it can be the most dangerous owing to leaking of poisonous liquids and poisonous materials into underground water.

This method is divided into two ways:

1- Random traditional pits dug by inhabitants or waste administration. These pits are not designed for this purpose, nor are they environmentally standard. This causes pollution of the area of dangerous material.

2- Industrial pits which are the best since they are equipped with industrial layers in the bottom. These are filters designed to prevent the leaking of poisonous materials into underground water. They are also equipped with a network of pipes designed to extract the gases emitted, particularly methane which is used in heating water and generating electricity after being burned.

**V. RESEARCH FRAMEWORK**

**5.1. Definition of Vital gas (Methane)**

Methane is the most abundant gas which results from decomposition of organic materials in the absence of air owing to bacteria activity. This is a flammable gas and it is more harmful to the environment than carbon dioxide, and it can explode if mixed with air.

**5.2. The most important gases resulted from decomposition**

- 1- Methane 70%
- 2- Carbon dioxide 25%
- 3- Other gases 5%: including carbon monoxide, hydrogen, ....ect [8].

**5.3. Organic materials which can be used in producing methane**

Fruit, vegetables, food waste, animal and poultry manure, leaves of trees, moving left grass, blank paper, tissue paper and toilet tissue, and a small percentage of cardboard. Regarding liquids; sewage water can be used.

All the above mentioned waste materials shouldn't be mixed with the following waste materials, oils and fats, meat and bone, dairy products, fish products, and wood and hay.

**5.4. The amount of methane which can be produces from Bio-solid waste in Gaza strip**

Gaza Strip produces approximately 1527.5 tone of Bio-solid Waste a day. Each ton produces 100 to 400 Cubic Meter of Methane [5], depending on the kind of waste and fermentation temperature which can help the activity of bacteria.

When Methane is used as fuel to generate electricity, each Cubic Meter of this uncompressed gas produces approximately 1.8 KW [5].

Table 2. The following table shows the minimum amount of Methane 100 Cubic Meter which can be produced from Bio- solid waste from 1 Tone [9]

Daily production	Cubic Meter per tons	KW per Cubic Meter	Daily production of KW	production of KW	Percentage of the daily consumption
1527.5	x 100	x 1,8	= 274950	= 11456	= 2,86 %

Table3. The following table shows the average amount of Methane 200 Cubic Meter which can be produced from Bio- solid waste from 1 Tone [9]

Daily production	Cubic Meter per tons	KW per Cubic Meter	Daily production of KW	production of KW	Percentage of the daily consumption
1527.5	x 200	x 1,8	= 549900	= 22912	= 5,72 %

Table3. The following table shows the maximum amount of Methane 400 Cubic Meter which can be produced from Bio- solid waste from 1 Tone [9]

Daily production	Cubic Meter per tons	KW per Cubic Meter	Daily production of KW	production of KW	Percentage of the daily consumption
1527.5	x 400	x 1,8	= 919800	= 45824	= 11,44 %

## VI. CONCLUSION

Since the average production of each ton of Bio-solid Waste is 200 Cubic Meter of methane, and since Gaza strip produces 1527, 5 ton of Bio-solid Waste a day, it is possible to produce approximately 305500 Cubic Meter of methane a day [9].

This amount of gas can be used in two ways:

- 1- Methane can be used in generators as an alternative to industrial fuel. The daily average amount of electricity which is 305500 Cubic Meter of methane can produce is estimate at 23MW which constitute 5.72% of the daily consumption which is 400MW in Gaza strip [9].
- 2- Methane is used in cooking instead of natural gas. This amount of gas can meet the daily need of 611000 people [9].

## VII. RECOMMENDATIONS

- Encouraging the Palestinians not to over produce solid waste in general and Bio-solid waste in particular.
- Motivating Palestinians to sort solid waste in its production place, such as houses, markets and farms.
- Developing and improving solid waste administration and making local programmers to rehabilitate workers in this field.
- Finding enough standard and environment friendly deposits in all parts of the country.
- Imposing strict rules against disposing of waste in random deposits.
- Supporting and constructing solid waste recycling stations.
- Making topics about the environment and waste recycling part of school curriculum.

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