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Electricity from Municipal Waste: A Potential Way to Meet up the Electricity Demand in Urban Bangladesh

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Abstract- Electricity is much more important for the development of a country & its countryman. Electricity is the key to development. Most of the people in Bangladesh are migrating from rural areas to urban areas in search of a better life. As a result the demand of electricity in urban areas in Bangladesh is increasing day by day. But the Govt. has less alternative to meet up the huge demand of electricity in urban areas. In this paper a comparative study is taken to generate electricity from municipal waste which is also in an increasing rate in urban areas because of over population. By sorting out the municipal solid waste and through anaerobic process we can generate biogas which will lead to generate electricity. In this paper, this electricity generation process is described along with annual municipal waste data in different urban areas in Bangladesh to give a road map to the proper authority so that they may find it helpful to meet up the increasing demand of electricity in urban Bangladesh.

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I. INTRODUCTION

Bangladesh is a densely populated country having a population of approximately 150 million [1]. It is one of the most promising developing countries in the world. The economic development of a country largely depends on the establishment of new industries. The availability of electricity gives pace to the establishment of new industries. Again in search of job and better life, a large number of people are migrating from rural to urban areas in Bangladesh. This makes a huge pressure of electricity demand – supply ratio in urban areas. For the shifted citizens and the newly established industries, Govt. has to arrange more electricity. But unfortunately the sources of electricity generation are very much limited. Moreover the conventional sources of electricity generation like coal; gases etc. are decreasing day by day. So, govt. has to find out better alternatives to supply the huge electricity demand in urban areas to continue the development process.

II. CURRENT URBANIZATION PROCESS & ELECTRICITY SITUATION IN BANGLADESH

In search of living, a great many people are shifting from rural areas to urban areas in Bangladesh. A survey indicates that in 1990 Bangladesh has a rural population of 92736985.1 where in 2010 it is 106909642.2 and the population growth rate in rural area is 0.5 % in 2010 [2]. On the other hand in 1990 Bangladesh has a urban population of 22895165.9 where in 2010 it is 41782488.8 and the annual growth rate in urban area is 2.9 % in 2010 [2] . So it is clearly indicating that the population is increasing much more rapidly in urban areas than the rural areas. Figure 1 shows the urban population situation in Bangladesh. [2]

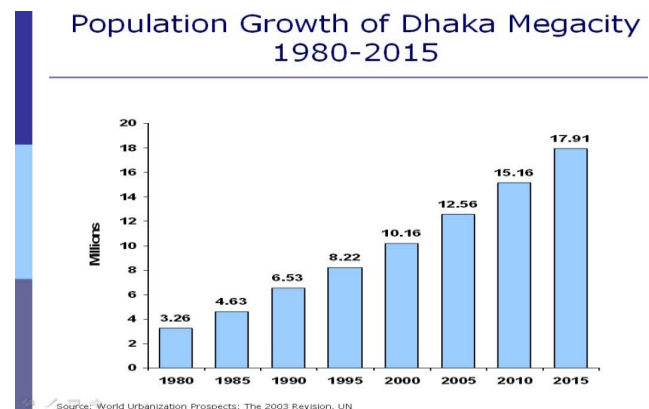


Figure 1 : Urban Population (Dhaka City) in Bangladesh

On the other hand though Bangladesh govt. is trying its best, but the demand – supply ratio of electricity is not satisfactory here. According to Bangladesh Power Development Board (BPDB) report, on 9 Sep -2014, maximum demand (substation end) at evening peak hour was 6356 MW whereas the maximum generation at evening peak hour was 6133 MW [3]. Table 1 shows a comparative study of demand and load shedding behaviour in different areas in Bangladesh [4].

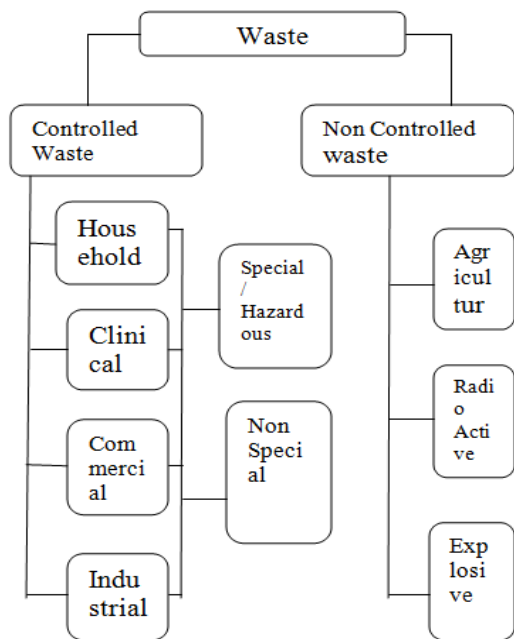
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Table 1 : Demand & Load Shed in Different Areas in Bangladesh as on 10/09/2014 [4]

AREA	Demand (MW)	Load Shed (MW)
Dhaka	2590	249
Chittagong	682	99
Khulna	730	112
Rajshahi	715	103
Comilla	440	70
Mymensing	370	45
Sylhet	320	28
Barisal	140	16
Rangpur	365	53
Total	6352	775

III. DEFINITION OF WASTES

Waste is termed as unwanted material. Waste and wastes can be various types like municipal solid waste (household thrash / refuse), hazardous waste, waste water, radioactive waste, and so on. According to the Basel Convention, "Wastes' are substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law" [5]. Waste includes any scrap material effluent or unwanted surplus substances or article that that requires disposal because it is broken, worn out, contaminated or otherwise spoiled [6]. Wastes are "those substances or objects which fall out of the commercial cycle or chain of utility" [7]. Figure 2 shows a waste classification framework [8].

**Figure 2 :** Waste Classification Framework [8]

IV. DEFINITION OF MUNICIPAL WASTE

Municipal Solid wastes (MSW) is more commonly known as thrash or garbage which consists of everyday items we use & then throw away. Such kind of things are food scraps, bottles, newspaper, paint, batteries, furniture, product packaging and so on. It also includes biodegradable waste, recyclable material, inert waste, electrical & electronic waste, composite waste, hazardous waste, toxic waste, medical waste etc. In developed municipalities without significant recycling activity it predominantly includes food wastes, market wastes, yard wastes, plastic containers and product packaging materials, and other miscellaneous solid wastes from residential, commercial, institutional, and industrial sources [9].

V. MUNICIPAL SOLID WASTE COLLECTION DATA IN DIFFERENT MUNICIPALITIES

a) Chittagong City Corporation (CCC)

Table 2 : Average Waste Generation in Chittagong City Corporation [10]

Description	LGR	MGR	HGR
Per capita domestic waste generation rate	0.25703	0.25703	0.25703
Population in CCC	2978711	3293373	3411339
Total domestic waste (ton)	765.629	846.507	876.828
Market waste (ton)	146.050	146.050	146.050
Street sweeping waste	138.234	138.234	138.234
Total waste (ton)	1049.913	1130.791	1161.113

Table 3 : Density of Waste in Chitagong City Corporation [10]

BROAD CATEGORY	Specific Category	Average density of waste (kg/m3)
Household	High income area	305.88
	Middle income area	313.73
	Low income area	326.47
Markets	Free-port Vegetable Market	617.28
	Riazuddin Bazar	617.28
Trucks	Truck 1.5 Ton	638.96
	Truck 3 Ton	798.00
	Truck 5 Ton	854.29
	Container Truck	1037.58
	Tractor Wagon	676.47

Table 4 : Physical Composition of Solid Waste in Chittagong City Corporation [10]

Component	Landfill Site (%)	Market (%)	Household (%)
Vegetable, Food	81.74	84.09	70.50
Bones, Fishbone	0.00	0.12	0.63
Paper	5.43	0.70	4.68
Plastic	10.60	2.34	8.70
Textile, Rags, Jute	0.04	5.62	2.40
Glass	0.00	0.67	0.00
Leather, Rubber	0.01	0.45	5.80
Metals	0.00	0.48	2.65
Ceramic	0.00	0.32	3.45
Soil, Ash	0.87	0.00	0.00
Grass, Creepers, Herbs, Wood	0.28	0.69	1.20
Medicine, Chemical	0.05	0.00	0.00
Miscellaneous	0.07	4.53	0.00
Feather/coconut shell	0.89	0.00	0.00
Total	100.00	100.00	100.00
Compostable	82.02	84.78	71.70
Non-compostable	17.11	15.22	28.30
Ash	0.87	0.0	0.0

b) *Rajshahi City Corporation (RCC)***Table 5 :** Average Waste Generation in Rajshahi City Corporation [10]

Description	LGR	MGR	HGR
Domestic Waste Generation Rate (kg/capita/day)	0.203	0.203	0.203
Population in RCC	551124	795451	882246
Total Domestic Waste (ton)	112.120	161.825	179.483
Market Waste	32.738	32.738	32.738
Total Waste (ton)	187.9	194.6	255.3

Table 6 : Density of Waste In Rajshahi City Corporation [10]

Broad Category	Specific Category	Average Density of Waste (kg/m ³)
Household	High income area	315.49
	Middle income area	320.27
	Low income area	325.67
Markets	Shaheb Bazar	280.95
	Laxmipur Market	279.76
Trucks	Truck 3 Ton	658.48

Table 7 : Physical Composition of Solid Waste in Rajshahi City Corporation [10]

Component	Household (%)	Market (%)	Landfill Site (%)
Vegetable, Food	82.05	83.65	79.4
Bones, Fishbone	0.27	0.13	0.37
Paper	4.40	1.23	2.3
Plastic	6.63	1.98	3.53
Textile, Rags, Jute	1.50	2.55	2.2
Glass	0.51	0.40	0
Leather, Rubber	0.22	0.20	0.85
Metals	0.00	0.13	0
Ceramic	0.33	0.38	0.39
Soil, Ash	3.60	8.21	10.51
Grass, Creepers, Herbs, Wood	0.42	1.12	0.45
Medicine, Chemical	0.07	0.00	0
Miscellaneous	0.00	0.00	0
Feather/coconut shell	0.00	0.00	0
Total	100.00	100.00	100.00
Compostable	82.47	84.77	79.85
Non-compostable	13.93	7.02	9.64
Ash content	3.60	8.21	10.51

VI. THE ELECTRICITY GENERATION PROCESS

In this process, a strong waste management system is very much important. Here electricity is generated from bio gas. To do this, the wastes should be sorted out according to their nature. In table 4 it is shown that the 82.02 % municipal waste is compostable waste in Chittagong City Corporation & in table 7 82.47 % waste is compostable in Rajshahi city corporation. So, it will be very much easier to sort out the collected waste according to their compostable nature (agricultural waste, cooked & raw food waste, fruits & vegetables wastes, fish & meat wastes, excreta of all domestic animals, waste water containing bio waste material) and non-compostable nature (plastic, glass and so on). We can only produce biogas from the compostable waste. Here we sort out the different types of waste first and then we collect the compostable or bio degradable waste for our purpose. Then this bio degradable waste is collected and then biogas is produced by an anaerobic process. This biogas is used in a gas generator to generate electricity. The whole process is shown in the following figure. This electricity generation process can be made more efficient and commercially more valuable by taking some more steps. If we place a gas filter between the biogas generation step and the gas generation step, then the efficiency of the electricity generation will increase. Again, we may produce organic fertilizer from the digester step which will be an

economic backup for this type of electricity generation process. A flow chart is shown above for better understanding.

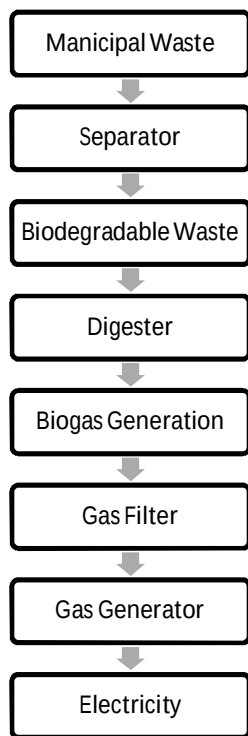


Figure 3 : Electricity Generation from Municipal Waste

VII. ADVANTAGES OF THE PROPOSED SYSTEM

- It will be helpful for the municipalities to generate their own electricity (at least to generate electricity for municipal purposes like street light, water pump etc.)
- It could be helpful to meet up the increasing electricity demand of the city dwellers.
- It could be helpful to minimize the waste management cost.
- It is a way to generate green energy.
- It will decrease the dependency on conventional electricity generation sources.

VIII. CONCLUSION

Electricity is a crying need for the development of Bangladesh. Again it is one of the most important aspects the government has to consider for the improvement of the lifestyle of its citizens. A huge amount of people in Bangladesh are shifting from rural to urban areas in search of better living. As a result the cities are becoming more power hungry compared to the rural areas. To supply electricity to this huge no. of city dwellers and to release the extra pressure electricity generation, "Electricity from municipal solid waste" can be a better solution in Bangladeshi scenario. Because

with the increase of populations in the urban areas it increases the municipal wastage amount. Which makes this electricity producing model not only very efficient but also it helps the urban areas becoming cleaner and environmentally sound. Hope that this process will be helpful for Bangladesh Govt. to supply the demanded electricity.

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