

WASTE COLLECTION AND INCINERATION PRACTICE: A CASE STUDY OF BANGLADESH

Lion Chandra Das¹, Md. Saidur Rahman²

Department of Civil Engineering, Pundra University of Science and Technology,
Rangpur Road, Gakul Bogra-5800, BANGLADESH.

¹litondascuetce09@gmail.com, ²saeed_hamim@yahoo.com.

Abstract- Bangladesh is a densely populated country with world ranked 8th but has low capacity. Population distribution is not uniform rural to urban areas. Due to heavy population in urban and city areas waste producing rate is expeditious. So these immense amount of disposed detritus needs to incinerate on low lying zone with proper ways. This paper deals with modern waste collection and incineration practices based on densely populated cities or towns like as Chittagong city and Bogra town of Bangladesh. This waste collection and incineration can refer the main waste-to-energy form of treatment. This treatment technology is involved destruction of solid waste by controlled burning at high temperatures. By the release of heat it can accompanied and this heat from combustion can be converted into energy. This type of incineration is a high-quality treatment for Municipal or City Corporation Solid Waste like as Bangladesh where over crowded cities, towns it can reduces the quantity and volume of large amount of waste to be land filled which can recover energy and dispose in compact zone. Although its count high economic investment but very precise to make environmentally safe avoiding emission control.

Keywords: Population distribution, Disposed detritus, waste to energy, combustion, municipal or city waste, compact zone, emission control.

1. INTRODUCTION

The world is moving fast with the help of modern technology. All the animals on the earth are getting preference with basic needs and fashioned living. Due to developing of economy and technology using of different things are also changing. With the economic advancement and population growth, the generation of solid waste is also increased tremendously in different areas of Bangladesh due to huge industrialization. Improper solid waste management is one of the most serious local environmental problems in our country. Waste mainly any material that is discarded, useless or unwanted. 'Wastes' are substances or objects, which are disposed of or are intended to be disposed of or are required to be incinerated of by the provisions of national law" (Basel Convention). The waste can be solid or hazardous but the authors have given special focus on solid waste (Haque et al., 2011). Materials are solid waste if they are abandoned by being disposed of or burned or incinerated; or accumulated, stored, or treated (but not recycled) before or in lieu of being abandoned by being disposed of, burned, or incinerated (Environmental

Protection Agency, 2012). In Bangladesh many of cities having highly populated are producing huge amount of these types of waste. Major cities like Dhaka, Chittagong, Khulna and Shylhet are considered to be among them. For the suitable analysis of major and minor patterns of research objective we had chosen two of cities in northern and southern portion of Bangladesh. Southern portion Chittagong city is most important for major concern with producing high amount of waste. Although Chittagong having the city of commercially important, its large portion is garments business which solid waste generation amounted as large. Some of the common solid waste materials observed in this city include paper, food waste, metals, plastics, glass or ceramics, vehicle parts and a small amount of e-waste. Most of these case which are known to be hazardous to the environment. These materials can have an economic benefit if managed accordingly for the sake of protection of the environment from pollution. Solid waste management refers all activities pertaining to the control, collection, transportation, processing and disposal of those in accordance with the best principles of public health, economics, engineering, conservation, aesthetics

and other environmental consideration (Alamgir & Ahsan, 2007). Although city is divided at 41 wards, 12 wards are most populated and solid waste generation is huge. Factories which are well known for its production specially garments factories and steel re-rolling machines are more responsible for producing waste production. The amount of solid waste in Chittagong city is approximately 2200 to 2400 ton /day. Many approaches are used for reducing the amount of waste in that area such as recycling, reuse, landfill etc.

On the other hand, Bogra is known as entrance point and so called capital of North-Bengal. Commercially and economically it is important of Bangladesh. The town have many industrial and residential areas. Bogra having 54 lacks population and various industries is producing various type of wastes in every day. From 20 wards of cities immense amount of waste are collecting in everyday. The Bogra Municipality does not have any solid waste processing and treatment system. Solid wastes are dumped on open areas through crude dumping without any treatment and sanitary land-filling (Islam et al. 2010) that degrade the environmental quality.

The main objectives of this research is to collect waste in proper way and utilize these wastes in incineration process. Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high temperature waste treatment systems are described as "thermal treatment". Incineration of waste materials converts the waste into ash, flue gas and heat. By converting wastes to energy we can use properly waste and as well as energy.

2. WORK METHODOLOGY

The study area was Chittagong City Corporation and Bogra town. Chittagong comprises 41 ward and two parts divided by Karnafuly river where one part is densely populated residential area and other one heavy industrial area. It is not so recent established area as a city corporation but it is one of the crucial municipal areas among the south-east part as well as whole Bangladesh. The population density of municipal area of Chittagong city is also very high which is about 20,000 to 30,000 per sq km. Its population is almost 3 million among which 54.99% male and 45.00% female (Banglapedia, 2014). The study was conducted from February to August 2017. The main points of view of the study are recyclable and reusable solid waste pattern. It also focuses on the present status of solid waste and its respective management practices. The study was carried out using several municipal inorganic wastes. The related term of this study is different types of solid waste collection, transportation, and storage and incineration system in selected area. These studies identify the collection of wastes and incineration accompanied with the authority future management plan with the proper consciousness of municipal residents about waste management. During the survey we were facing the ignorance and unwilling cooperation to the field workers and officials as well as

inadequate transparency of their information. Both qualitative and quantities data were collected. Primary data collected by field observation of the study areas focusing group discussion with the stakeholders. Secondary information collected for proper documentation like research articles, books, and periodicals.

3. SURVERY ON FIELD

In Chittagong for primary data collection we needed to divide our research area into two parts. One was heavy industrial area opposite side of Karnafully River and another was densely populated residential area, ward no. 31,32,34,21,22 etc. On the other hand in Bogra town there have 20 wards, 8 major of them were selected. Those eight were heavily populated residential areas and industrial areas. To find out the solid waste management practice in the study area the primary data was collected from mainly various classes of people of the selected sector and the respondents were selected randomly. The primary data was collected through questionnaire survey from hawker, day labor, rickshaw/van puller, business man, job holder to assess the exact situation of solid waste management with direct field observation. Primary data was also collected by visited the waste collection site and different small private agency. Visiting the selected ward as well as sighting the dustbin of the road site and its situation was also observed.

4. OFFICIAL SURVEY

These types data collection were secondary data. Secondary data about population, volume of waste generation, activities exiting on solid waste management in selected study area were collected. It was collected from Chittagong city corporation office and Bogra municipal office. For assessing expert opinion the key informant interview was conducted with the various stakeholders who were expert and associated with solid waste management practice in the selected area. The engineers of municipality of Chittagong and Bogra along with the planner are given an opinion about present solid waste management with their upgrading process for better solid waste management. They are strongly concern about management by incineration practices. According to technical team of these two major and minor cities they want to utilize those wastes to convert energy.

5. DATA ANALYSIS

Depending on areas waste patterns were different. Main two types industrial waste and residential waste. These wastes may organic or inorganic. Though solid can be organic or inorganic but the study mainly based on the inorganic solid waste. The findings of the study on solid waste are that the waste consists of several components mainly plastic, paper, metal, e-waste, vehicle parts in residential areas. Rubbish, garbage, trash, junk, slags, fly ash, solvent acidic water etc. Different elements and sources are shown in Table:1 and Table: 2:

Table 1: Residential wastes

Products	Wastes
1.Paper	Paper scraps, cardboard, newspapers, magazines, bags, boxes, wrapping paper, telephone books, shredded paper, and paper beverage cups
2.Plastic	Bottles, packaging, containers, bags, lids, cups.
3.E-waste	Broken TV, radio, computer, wires.
4. Metal	Tins, non-hazardous aerosol cans, appliances (white goods), railings, fishing too
5.Vehicle parts	Bicycles, Automobile parts, shipping unusable parts.

Table: 2 Industrial waste

Products	Wastes
1.Textile	Dyes, heavy metals, organic chlorine compounds, solvents.
2. Cement	Slag, fly ash, chemical ingredients
3.Paints	Heavy weight particles, solvents, pigments, organic residues.
4. Pesticides	Organic chlorine compounds, organic phosphate compounds
5.Petroleum	Oil, phenol, organic compounds
6. Medicines	Organic solvents and residues, heavy metal (mercury, zinc).

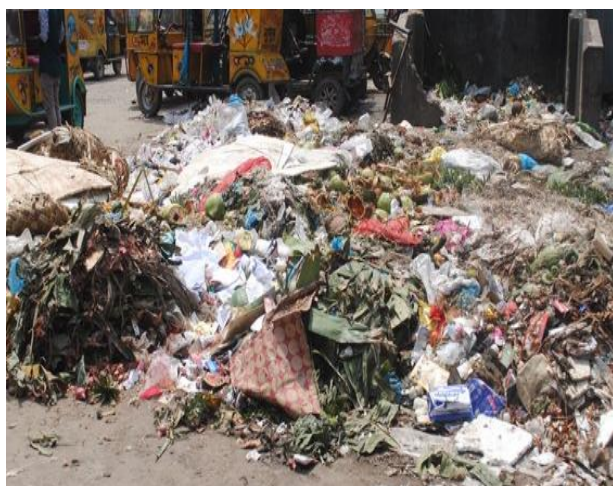


Fig 1: Solid Waste in Bogra Municipality



Fig 2: Solid waste in Chittagong City

6. COMPOSITION OF SOLID WASTE

Solid waste contamination is so high with inorganic materials. Residential wastes pattern and industrial waste typically different but gets some similarity also. Amount of waste pattern generated from usable things bellow.

Table-03: Waste amount in Chittagong City Corporation

Waste	Products	Amount (Kg/capita/day)
1. Residential	Paper	0.142
	Plastic	0.091
	E-waste	0.011
	Metals	0.008
	Vehicle parts	0.013
	Domestic things	0.019
2. Industrials	Textile	0.024
	Cement	0.012
	Paints	0.015
	Pesticides	0.017
	Petroleum	0.018
	Medicines	0.023
Total Collection		0.476

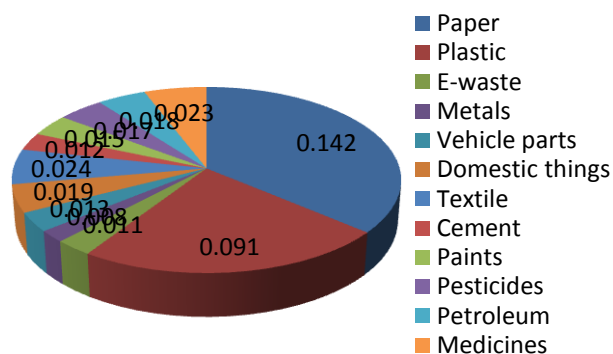


Fig 03: Typical pattern of solid waste in Chittagong.

Table:04 Waste statistics in Bogra Municipality

Waste	Products	Amount (Kg/capita/day)
1. Residential	Paper	0.147
	Plastic	0.091
	E-waste	0.011
	Metals	0.008
	Vehicle parts	0.002
	Domestic things	0.019
2. Industrials	Textile	0.014
	Cement	0.012
	Paints	0.001
	Pesticides	0.001
	Petroleum	0.018
	Medicines	0.013
Total collection		0.367

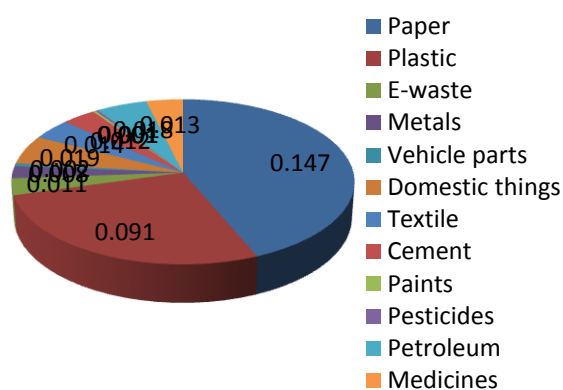


Fig 04 : Typical solid waste in Bogra Municipality.

This statistics show that total amount of solid waste produced in Chittagong City is 1881.71 tons per day and in Bogra town its cross by 473.74 tons per day. All over the country in highly populated cities are also producing a huge number of wastes depending on session of a year.

Table 5: Solid waste generation based on session

S.I	City Town	WG (Kg/cap/d)	TWG (Tons/d)		Average WG (tons/d)
			DS	WS	
1	Dhaka	0.58	2282.546	3724.15	6006.7
2	Chittagong	0.48	715.07	1166.65	1881.71
3	Sylhet	0.43	38.73	63.18	101.91
4	Rajshahi	0.41	109.08	177.97	287.05
5	Khulna	0.36	183.63	299.6	483.24
6	Barisal	0.32	24.59	40.13	64.72
7	Pourashavas	0.28	2557.48	4172.73	6730.23
8	OtherUrban Center	0.21	1076.98	1757.19	2834.17
Total Solid Waste (tons/day)					18389.73

WG- Waste Generation;
 TWG- Total Waste Generation;
 WG- Waste Generation
 DS- Dry Session;
 WS- Wet Session

All over the countries in major developed cities generate

approximately 18389.73 tons/day. Composition of these waste is majorly organic and inorganic. Physical characteristics of the collected waste stream, like waste composition fraction on wet weight basis, dry weight fraction, and moisture content, are critical factors to determine energy recovery alternative. Similarly, chemical properties, such as organic carbon (C_{org}), inorganic carbon (C_{inorg}), hydrogen (H), oxygen (O), nitrogen (N), sulphur (S), and ash content of solid waste, also influence this decision. Physical characteristics of collected solid waste stream of Bogra and Chittagong city were determined by segregating the solid wastes at the primary level (source), secondary level (dustbin along the street), and third level (SWDS). Quantification and percentage of different solid wastes were calculated from 5 kg sample. Standard molecular composition of different solid wastes category based on dry weight fraction of solid waste was used in this study.

7. INCINERATION PRACTISE

Waste incineration is the combustion of solid and liquid waste in controlled incineration facilities. Modern refuse combustors have tall stacks and specially designed combustion chambers, which provide high combustion temperatures, long residence times, and efficient waste agitation while introducing air for more complete combustion. In combusting process energy content of solid waste highly influences the waste combustion processes in an incinerator to generate the electricity. For generation of electricity by combusting solid waste, unsegregated wastes feed stock combusted in a furnace or boiler, under high temperature (980 to 1090°C) conditions with excess oxygen. Solid waste feed stock is converted into heat, flue gases and particulates, and incinerator bottom ash. The heat is used to produce steam and based on the Rankine cycle principle in steam turbine electricity is generated. Under ideal situation solid waste combustion processes chemical reaction is represented using following equation,

Organic matter (C_{org}) + Excess air (Mainly O_2) = CO_2 + H_2O + O_2 + N_2 + Ash + Heat.

This exothermic reaction produces heat by lower heat. Produced high heat can be used in different sectors with its requirements. Among these sectors electricity generation is most important. Incinerators reduce the solid mass of the original waste by 80–85% and the volume (already compressed somewhat in garbage trucks) by 95–96%, depending on composition and degree of recovery of materials such as metals from the ash for recycling. This means that while incineration does not completely replace landfilling, it significantly reduces the necessary volume for disposal. Garbage trucks often reduce the volume of waste in a built-in compressor before delivery to the incinerator. Alternatively, at landfills, the volume of the uncompressed garbage can be reduced by approximately

70% by using a stationary steel compressor, albeit with a significant energy cost. In many countries, simpler waste compaction is a common practice for compaction at landfills.

8. CONCLUSION

Waste is said to be a mirror of the society since waste generation and disposal reflect a range of aspects of the society such as its economic, historical, cultural and environmental components. In Bangladesh specially densely populated city areas, the amount of solid waste is increased day by day. But its management system and disposal site are not quite enough developed. The study said that the estimated value of the total solid waste all over the country in major cities is 18389.73 tons/day. Among all waste the convertible components of solid waste and some of waste consist of organic and inorganic carbon. This waste was categorised in organic parts which is convertible in energy. Most of people in the Chittagong City and Bogra Municipality said that the municipal waste collection with management system is very poor and weak than the necessity. Solid waste generation is in increasing trend with the growth of urban population. The country is generating about 18389.79 tons of solid waste each day from the six major cities (Dhaka, Chittagong, Khulna, Rajshahi, Barisal and Sylhet), of which Dhaka city alone is contributing about 70%. This high amount of waste can be used as incineration practices. Incineration coupled with high temperature waste treatments are recognized as thermal treatments. During the process of incineration, the waste material that is treated is converted in to IBM, gases, particles and heat. These products are later used for generation of electricity. The gases, flue gases are first treated for eradication of pollutants before going in to atmosphere.

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