EVALUATION OF ENERGY CONTENT IN MUNICIPAL SOLID WASTE OF LOW-INCOME AREA TEHKAL AND HIGH-INCOME AREA HAYATABAD OF PESHAWAR K.P.K PAKISTAN

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Abstract- In developing countries like India and Pakistan, municipal waste creation is increasing rapidly because of ongoing population, urbanization, and industry growth. In addition to having a detrimental impact on the environment. Managing MSW effectively and producing sustainable non-fossil fuel, energy can both be accomplished by converting trash to energy. This study aims to provide a thorough assessment of the energy content of municipal solid waste (MSW) from high-income area Hayatabad and low-income area Tehkal of Peshawar city KPK Pakistan. First, selected the solid waste sample in plastic bags from the dumpsite in the low-income area Tehkal and high-income area Hayatabad of Peshawar city K.P.K Pakistan. Each sample was 100 kg from both the areas. The collected waste is separated to different component of solid waste. Then find the moisture content of each component in MSW. It almost took 3 to 4 weeks to collect this data. After finding the dry weight, find the energy content of high-income zone, which was found out to be 28026.7292kJ/100 kg, and for low-income zone, it was 14794.7395kJ/100kg.

Keywords- Energy Content, Municipal Solid Waste (MSW), Moisture Content, Waste Composition.

1 Introduction

Developed nations generate a greater amount of waste than developing nations. Nonetheless, because they have strong management systems, they produce significant amounts of energy from these wastes. Due to the high cost of MSW management and producing energy from it, it is a significant issue in developing nations like Pakistan. The handling of MSW is not merely a technical problem; a number of legal, political, ecological, and financial variables influence it [1]. Approximately 60% of solid garbage is collected, while the remainder is left at collecting places or in streets, emitting toxins and rendering the environment unfit for human interactions [2].

Municipal solid waste includes degradable, partially degradable, and non-biodegradable items such paper, textiles, food waste, straw, yard trash, leather, plastics, rubbers, metals, glass, ash, dust, and electronics [3]. The findings imply that total worldwide trash generation would be roughly 20 billion tons in 2017. This equates to 2.63 tons of total garbage per person (cap) each year. Under the current business-as-usual scenario, worldwide trash production is predicted to reach 46 billion tons by 2050 [4].

MSW recuperation can be in many ways, such as composting, which is the process of recycling biodegradable parts of MSW through a number of technological processes and thermochemical therapy, which comprises of pyrolysis, gasification, and incineration [5]. From the above, it is clear that there is potential to produce energy from MSW by incineration which involves burning garbage at high temperatures in order to produce heat that can be used to produce power and heat buildings. Biodegradable are those that decompose spontaneously in the environment, such as vegetable peels and natural textiles. These are used to produce energy manure, compost and biogas. Non-biodegradable substances are those that cannot naturally decompose in the environment, such as plastic and metals. These can be separated and recycled but it may be very costly.

The purpose of this research work is to assess the potential power that can be generated from municipal solid trash in two diverse areas of Peshawar, K.P.K Pakistan, specifically the low-income area Tehkal and the high-income area Hayatabad of Peshawar city KPK Pakistan. The results of this study will provide helpful information regarding the capability of producing energy via MSW in the region under study, as well as help alleviate the region's energy shortfall and waste management concerns. This study paper will contribute to the current collection of literature on how to handle MSW and provide the groundwork for long-term waste to energy conversion practices in Peshawar's low-income area Tehkal and high-income area Hayatabad.

2 Research Methodology

2.1 Sample collection

We collected 100 kg sample of solid municipal waste from the largest MSW disposal place, located in high and low-income areas of Peshawar city KPK Pakistan. The 100 kg sample was collected in one week. In every day of the week 14.38 kg was collected. The dumpsites are shown in Figure 1 respectively.

a)  b) 

Figure 1: Dumpsites a) Tehkal Low-Income Area Dumpsite and b) Hayatabad High-Income Area Dumpsite

2.2 Characterization and Physical analysis of MSW

The municipal waste (MSW) specimen was characterized by manually separating and classifying it into various components. The components in MSW were separated manually. The mass of each element in the total MSW specimen was measured using a device known as a digital balance

Moist percentage

To determine the amount of moisture of individual components, everyone was freshly weighed via an electronic balance and dried inside an oven at 100°C for 3 hours.

3 Results

In Tehkal, a low-income neighborhood, garbage is primarily composed of biodegradable products, with a minimum proportion of recyclables. Tehkal's trash is largely biodegradable with few recyclables, demonstrating the complex interplay of economic, cultural, infrastructural, and behavioral elements in waste management in low-income communities. In contrast, the high-income region of Hayatabad, non-biodegradable products have a higher percentage, reflecting a more consumer-oriented lifestyle.

Table 1 shows the waste components, percentage composition, moisture content, dry unit weight, and total energy based on a 100 kg sample from the high-income area Hayatabad. The outcome of the table 1 is the energy calculated present in 100 kg of sample which is collected from high-income area Hayatabad.

Table 1: Total energy based on 100 kg of sample of high-income area Hayatabad

S.No	Components	Composition % by weight (total 100kg)	Moisture Content (%)	% Dry Weight (kg)	Default energy values (KJ/Kg)	Total energy (KJ/Kg)
1	Plastic	14.1	2	13.818	32600	600466.8
2	Paper	8.5	6	7.99	16750	133832.5
3	Cardboard	7.6	5	7.22	16300	117686
4	Food waste	10.5	70	3.15	4650	20647.5
5	Yard waste	11.2	60	4.48	6500	29120
6	Textiles	3.9	10	3.51	25400	159154
7	Glass	5.8	2	5.684	1650	9378.6
8	Tin Cans	2.8	3	2.716	700	1901.2
9	Tetra Pack	5.6	11	4.984	12000	59808
10	PET Bottles	9.3	4	8.928	29400	392483.2
11	Ash/ Sand	3.3	26	2.442	250	610.5
12	Polythene	7.2	18	5.904	15690	92633.76
13	Wood	8.6	36	5.504	18600	152374.4
14	Rubber	1.6	2	1.568	23750	40240
15	Total	100	-	77.898	-	2802672.92

Energy Value = 2802672.92kJ/100kg

Energy Value in kJ/kg for high-income area Hayatabad = 28026.7292kJ/kg

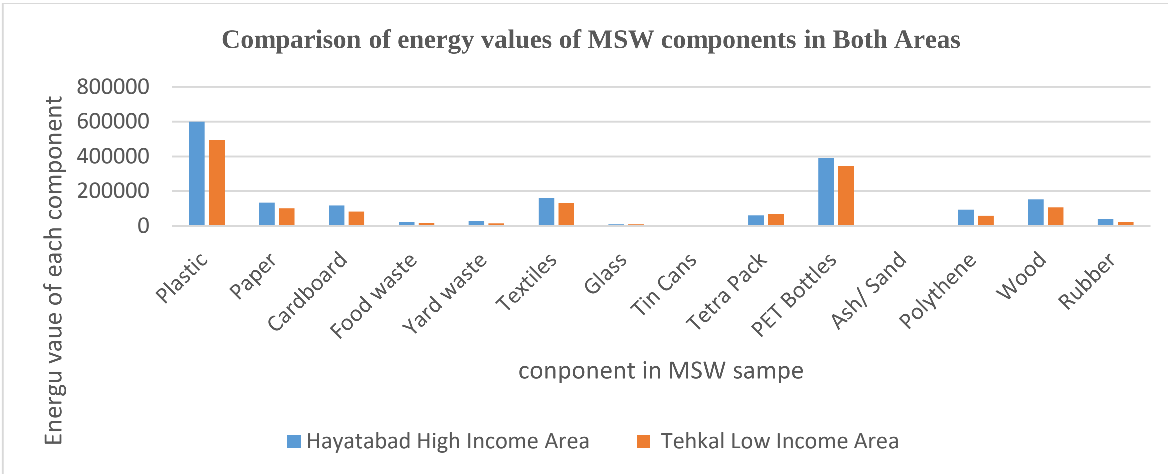
The component of waste, its percentage composition in 100 kg sample, moisture content and dry unit weight of MSW and Total energy based on 100 kg of sample of low-income area Tehkal is calculated given below in the table 2.

Table 2: Total energy based on 100 kg of sample of low-income area Tehkal

S.No	Components	Composition % by weight (total 100kg)	Moisture Content (%)	% Dry Weight (kg)	Default energy values (KJ/Kg)	Total energy (KJ/Kg)
1	Plastic	16.1	6	15.134	32600	493368.4
2	Paper	6.5	8	5.98	16750	100165
3	Cardboard	5.6	10	5.04	16300	82152
4	Food waste	8.2	60	3.28	4650	15252
5	Yard waste	3.5	40	2.1	6500	13650
6	Textiles	5.6	8	5.152	25400	130860.8
7	Glass	4.9	3	4.753	1650	7842.45
8	Tin Cans	2.7	2	2.646	700	1852.2
9	Tetra Pack	6.3	10	5.67	12000	68040
10	PET Bottles	12.4	5	11.78	29400	346332
11	Ash/ Sand	9.5	25	7.125	250	1781.25
12	Polythene	5.7	35	3.705	15690	58131.45
13	Wood	10.6	46	5.724	18600	106466.4
14	Rubber	2.4	6	2.256	23750	53580
15	Total	100	-	80.345	-	1479473.95

Energy Value = 1479473.95kJ/100kg

Energy Value in kJ/kg for low-income area Tehkal = 14794.7395kJ/100kg



Comparison

The MSW in high-income area Hayatabad exhibited a higher calorific value, attributed to the increased presence of non-biodegradable materials, which have a higher energy content when incinerated. Low-income area Tehkal produces the lowest calorific value because MSW has the possibility for energy recovery via organic waste digestion and biogas production. It is observed from the energy values if in the future we have to install the energy generation plant in these regions then high-income area Hayatabad is preferred over low-income area Tehkal. The research highlights the importance of efficient waste management, including tailored methods, optimal collection schedules, improved segregation and recycling, and Waste-to-Energy facilities, which can reduce landfill dependence and achieve renewable energy targets.

4 Conclusion

The energy content disparities between Tehkal and Hayatabad highlight the need for waste-to-energy solutions in every city, especially in areas with higher energy content. Specialized solutions are needed in Peshawar City for sustainable development and maximum energy recovery. The study suggests developing effective waste management strategies to enhance resource utilization and minimize environmental harm, requiring careful planning, regulation, and public engagement for waste-to-energy adoption. This study highlights the importance of localized initiatives in waste management and renewable energy, emphasizing the need for stakeholder engagement to develop sustainable, equitable solutions.

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