

SOLID WASTE ANALYSIS AND CHARACTERIZATION STUDY: INPUTS FOR WASTE-TO-ENERGY TECHNOLOGIES BASED PROJECT IN STATE UNIVERSITY

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ABSTRACT

Universities face environmental and logistical challenges because they generate a large amount of solid waste. This study assessed the potential of waste-to-energy (WtE) technology for a state university's waste management practices. A solid waste analysis and characterization study (SWAC) was conducted to determine the feasibility of WtE adoption on the campus. This analysis effectively determined the composition of solid waste generated. The study discovered that a considerable part of garbage generated may be recycled, suggesting more effective recycling methods should be established to significantly decrease waste. Additionally, a significant amount of mixed waste was identified, which could be a suitable fuel source for WtE technologies given the energy content of different types of waste, mixed waste was identified as a potential resource for conversion processes such as plasma or gasification. This study also emphasized the importance of the drying methods of the waste for the SWAC study which is essential when choosing WtE technology. The waste analysis data show that mixed solid waste, with a moisture content of 25.25% and a calorific value of 26.86 MJ/kg, is suitable for plasma technology. Plastic bottles (46.56% moisture, 22.53 MJ/kg calorific value), plastic cups (5.13% moisture, 41.4 MJ/kg), plastic bags (29.29% moisture, 40.8 MJ/kg), and cardboard (26.83%, 27 MJ/Kg are ideal for pyrolysis. Bond paper, mixed Paper, and kitchen food waste, with moisture contents of 24.36%, 17.37%, and 17.87% and calorific values of 13.5 MJ/kg, 15.02 MJ/Kg, and 13.66 MJ/kg are best produced anaerobically. Wood, with a moisture content of 22.12% and a calorific value of 14.4 MJ/kg, respectively, are suited for gasification. Styrofoam, with a moisture content of 43.73% and a high calorific value of 40 MJ/kg, is also suitable for pyrolysis. Rock with a moisture content of 18.86% and a calorific value of 1.8 MJ/Kg is not suitable for any WtE technology. Lastly, garden waste, with a moisture content of 38.82% and a calorific value of MJ/kg, respectively, is best handled anaerobically. Generally, the findings pave the way for a well-informed decision on the most suitable waste-to-energy technology for the university. By harnessing the energy potential of its waste stream, the university can contribute to a more sustainable future while reducing its reliance on landfills.

Keywords: Solid Waste Management, Waste Characterization, Waste-to-Energy, State Universities, Sustainable Waste Management

1. INTRODUCTION

The origin of the word waste came from the Latin word “vastus” meaning a space that is void, immense or enormous. It refers to something useless and harmful to humans that should be ignored and abandoned. Waste is an inevitable result of the vast majority of human actions. Progress in the economy and improved living conditions across Asia and the Pacific has resulted in more waste being produced, both in quantity and complexity. In the last half century, there has been substantial growth in urban cities globally, and experts predict that this pattern will persist. The rising populations coupled with rapid urbanization areas put enormous stress on local governments, especially in developing countries [1,2].

Our planet faces a mounting issue with garbage. Managing all this waste (often called SWM for short) is becoming trickier as the world throws away more and more stuff. This growing garbage mountain has major downsides for our air, water, soil, and even our health. Landfills, the traditional dumping grounds, are filling up fast and causing problems. Contaminants can seep into the water we drink, and the methane gas they release contributes to climate change. To tackle this challenge, new technologies are emerging that turn trash into energy, offering a potential solution to both waste disposal and energy needs [3,4,5]. The passing of the Ecological Solid Waste Management Act (RA 9003) in the Philippines was a response to rising public and environmental worries about solid waste. A crucial element of this legislation is the requirement for educational institutions to serve as community-based organizations, highlighting their vital contribution to the effective implementation of solid waste management practices [4].

The policy mandates the Department of Environment and Natural Resources to provide secretariat support to the National Solid Waste Management Commission in the implementation of the solid waste management plans and prescribes policies that focus on the dissemination of information, consultation, education and training on ecological

waste management [6]. As vital engines of societal progress, universities require extensive infrastructure and waste management systems, mirroring the complexity of small cities. Hence, universities are expected to be the key drivers in the efforts directed towards clean and friendly environments through the implementation of responsible waste management policies. Greening the waste economy and HEIs are two initiatives aimed at achieving a green economy and sustainable development. All parties connected with the management of waste at HEIs need to be fully engaged in exercising awareness and engagement in the execution of greening projects. The Don Honorio Ventura State University (DHVSU) is one of the ever-progressive state universities in Region III and is currently subjected to the plight of sustainable waste management due to its exponential population growth.

The global community faces a growing challenge in managing waste effectively. The World Bank recognizes various techniques like source reduction, reuse, recycling, collection, composting, incineration, and landfilling [7]. However, the effectiveness of these methods depends on various factors specific to each location and institution. Several research on effective waste management at educational institutions have been carried out throughout the years. For example, [8] carried out a study on solid waste characterization and recycling potential at the Catholic University of East Africa while researching the management of garbage at a Kenyan educational institution with a focus on sustainability. Furthermore, [9] studied the greening of HEIs through sustainable waste management and [10] assessed Mwanza, Tanzania's public educational institutions' waste management practices. It has been noted that efforts to achieve a green economy, poverty eradication, and sustainable development involve both the greening of HEIs and the waste sector.

Whereas, Starovoytova [11] analyzes the composition and amount of squander and recognizes openings for materials recuperation of a college moreover in Kenya. Besides, Zhang's [9] investigation of how economical squander administration might offer assistance HEIs have gotten to be greener, and Sepetu's [12] appraisal of junk administration in Mwanza, Tanzania's open instructive teaching. It has been famous that endeavors to attain a green economy, destitution destruction, and maintainable improvement include both the greening of HEIs and the squander division. All parties included, counting understudies, workforce, regulatory staff, and the quick neighborhood community, must lock in and raise mindfulness of one another's willingness to effectively take part within the usage of greening programs in order to effectively oversee the squandering in HEIs.

Squander administration and vitality frameworks are regularly interlinked, either specifically by WtE advances, or in a roundabout way as forms for recuperation of assets utilize vitality in their forms or substitute ordinary generation of the commodities for which the reusing forms give crude materials. Vitality recuperation from squander by WtE-plants is a case of coordinate associations between vitality and squander administration [13].

The WtE speaks to a promising elective vitality source with financial possibility and biological supportability. It examines the current worldwide scene of WTE advances, enveloping cremation, pyrolysis, gasification, anaerobic absorption, and gas recuperation from landfills, for an effective vitality era. It moreover dives into the challenges experienced by both created and creating countries. Pyrolysis could be a preparation that breaks down natural materials into fluid bio-oil, gas, and char through warm. Gather created and built a versatile one-ton per day pyrolysis exhibit unit based on a reactor plan called the combustion lessening coordinates pyrolysis framework (CRIPS) beneath pyrolysis has technologies of feedstock arrangement, pyrolysis reactor, and warm decay [14]. Gasification this securely turns squander into syngas (union gas) by responding it with controlled sums of oxygen or steam. Besides, Gasification has the innovations of gas turbines, inner combustion motors, steam turbines [15]. Anaerobic digestion has a yield of biogas vitality that will be utilized within the same ways as common gas to function cooling frameworks, create power, and give warmth. Anaerobic absorption has innovations of absorption handle and biogas generation. Too digs into the challenges experienced by both created and creating countries [16]. This survey sets up a system for surveying WtE innovations, drawing experiences from case ponders in both created and creating locales. In creating nations, unsanitary landfilling remains a predominant transfer home, whereas created countries have recognized the potential of WtE innovations in progressing metropolitan strong squander administration (MSWM) [17]. To decrease the hazard of climate, alter and bolster a maintainable future, governments and businesses around the world are contributing in renewable sources of vitality such as wind, hydropower, sun oriented, biomass, and geothermal. After a long time, the costs of renewable vitality are declining quickly and becoming cost-competitive against fossil fuel-based options in numerous nations [18]. The 2023 Circularity Hole Report reveals that only 7.2 percent of the global economy follows circular hones. This diminishment in worldwide circularity, from 9.1 percent in 2018 to 7.2 percent in 2023, is credited to the expanding extraction and utilization of materials, coming about in a considerable hole in accomplishing a circular economy. Eminently, the majority of materials, more than 90 percent, go to squander, get lost, or stay inaccessible for reuse for drawn out periods, as famous by Ramachandran [19]. Within the setting of vitality generation and speculation costs, optimization results uncover an unmistakable positioning of waste-to-energy (WTE) advances. Several methods using high temperatures, like incineration, gasification, and pyrolysis, are popular in Waste-to-Energy (WtE) facilities

[20]. Incineration is a common choice for solid waste disposal because it significantly reduces waste volume and can generate electricity and heat [21]. When electricity prices are ideal (around 3 cents per kilowatt-hour), incineration offers the best economic return on investment [Source 3]. Gasification and pyrolysis are also economically viable at higher electricity prices (7 cents/kWh and 12 cents/kWh respectively). However, with current electricity prices at 11 cents/kWh, investing in pyrolysis might not be the most financially sound decision at this time [21]. To make pyrolysis more competitive with landfills, the tipping fee for landfilling waste would need to increase from \$15 to \$18.5 per ton. This economic shift would make pyrolysis a more attractive alternative [22].

The main objective of the study is to conduct waste analysis and characterization to process waste and convert it to different types of waste-to-energy technologies. Specifically, it aims:

1. To identify the different types of waste generated on the campus.
2. To determine the quantity of the volume of waste generated inside the campus.
3. To analyze the solid waste samples based on their physical and chemical composition.; and
4. To determine the most suitable waste-to-energy technology for managing the specific types of waste generated

2. METHODS

2.1 Solid Waste Analysis Composition Study

The study involved conducting Solid Waste Analysis Composition Study (SWACS) to provide important information on waste generated in the university as a basis for the determination of possible Waste-to-Energy solution. It includes the following elements: planning and mobilization (waste collection), solid waste composition study (SWACS), waste quantity analysis (waste sorting and weighing of waste), and moisture content analysis.

2.1.1 Planning and Mobilization- The planning and mobilization activities includes (1) planning meetings regarding logistics; (2) preparation of schedule for sampling; (3) orientation for the maintenance (garbage collectors) including health and safety training.

2.1.2 Waste Composition Study- The quality of the waste composition data was highly affected by the sampling procedure. [23] [24] Thus, the study was conducted in compliance with ASTM D5231-91, which included procedures for the collection of a representative sorting sample of unprocessed waste and manual sorting of the waste into individual waste components (ASTM D5231-92, 2003 - American Society for Testing and Materials - Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste).

2.2 Research Area

This research was conducted at the Main Campus of Don Honorio Ventura State University (DHVSU). The campus covered a land area of approximately 79,000 square meters and had a population of 25,598 students and staff. Solid waste generated within the campus was also collected from designated waste collection points across the campus and transported to a central garbage bin..

2.3 Solid Waste Quantity Analysis

The researchers defined the total weight (W) of waste collected per day as the sum of the weights of the individual waste samples collected that day. This formula basically involves calculating the total daily waste collection by adding the weights of all individual samples collected in a single day. [25]

$$G_{\text{total}} = \sum_{i=0}^n G_n$$

Where:

G_T = Generation of solid waste of the university (kg/day)

G_N = Weight of the nth sample of waste collected per day (kg/day)

N = Total number of samples collected per day

The waste component generation rate was estimated based on the percent composition and the per capita waste generation rate/coefficient [21]:

$$G_R = \frac{G_T}{M(10^{-3})(365)}$$

Where:

G_T = Generation of solid waste of the university (kg/day)

G_R = Solid waste generation-coefficient (kg/person/day)

M = population in the university

2.4 Moisture Content Analysis

Moisture content analysis was performed on key components of the waste stream as part of the waste characterization process. Due to limitations in available equipment, an air-drying method was employed. Pre-weighed containers were used to collect representative samples of different waste components. The weight of each container with its corresponding sample was recorded (wet weight). Subsequently, the samples were air-dried for 10 days. Once completely dry, the containers and samples were weighed again (dry weight) [26].

$$\% \text{ Moisture} = \frac{(\text{Weight}_{\text{BD}} - \text{Weight}_{\text{AD}})}{\text{Weight}_{\text{BD}}} \times 100$$

Where:

Weight_{BD} = weight of waste before drying (kg)

Weight_{AD} = weight of waste after drying (kg)

3. RESULTS AND DISCUSSIONS

3.1 Solid Waste Physical and Chemical Composition.

It is observed that the university mainly throw away different types of waste including paper, cardboard, plastic, food scraps, yard waste, and other organic and inorganic materials. This study analyzed the physical and chemical composition of solid waste such as weight, moisture content, and calorific value which are important in choosing suitable WtE Technologies. The researchers did not consider liquid waste in this study. However, the solid waste generated in the campus is often mixed with liquid waste which increase its moisture content of the waste. This why it is important to conduct SWACS in the university since it is used in utilization in WtE technologies.[27]

3.1.1 Solid Waste Characterization

A ten-day solid waste characterization study was conducted to determine the composition of solid waste generated on campus. The Material Recovery Facilities under the Office of Physical Plant and Facilities and Occupational Safety and Health Office categorized the waste into four classifications: residual, plastic bottles, other recyclable materials, and biodegradable waste.

Table 1. Estimated Daily Waste Generation in the Campus

Waste Category	Kg/ day	Percentage
Residual – Polythelene sac/Plastic bag, Styro	115.21 kg/day	23.31%
Plastic Bottles	144.87 kg/day	29.31%
Other Recyclable Materials – Paper, Plastic Cups, Spoon and Fork	192.91 kg/day	39.03%
Biodegradable Materials – Food & Garden Waste	41.27 kg/day	8.35%

The researchers weigh the waste into kilograms/day to get a total of 5% sample which is equivalent to 1,220 students and 60 employees. The generated wastes in the university are residual waste, plastic bottles, other recyclable materials, and biodegradable materials. The study revealed the highest waste generated in the university in terms of kilograms is recyclable materials with 39.03% followed by plastic bottles, 29.31%, and then residual waste with 23.31% share as seen in table 4. Biodegradable waste generated in the university was the least generated category which has a minimal share or 8.35% of the total generation.

3.1.2 Total Waste Quantity

To determine the total waste at DHVSU, the process is through planning and mobilization is applied. This process established the effectiveness of Solid Waste Analysis Characterization Study (SWACS). During the data collection, waste from each designated category is collected at predetermined intervals and weighed using calibrated scales. A detailed record of the weight of waste from every type of waste like (bond paper, pad paper, paper cups, and cardboard), plastic items (including PET bottles, spoons and forks, plastic wrappers, and plastic bags), styrofoam products (like cups and plates), construction debris, yard waste (such as twigs, leaves, and stones), and other materials (including tissues and receipts).

The total quantity of waste generated each day is obtained at the university is obtained by summing the weights of individual waste materials. The summation of sample waste provides the total waste generated per day. Based on the analysis, the average daily waste generated at DHVSU- Main Campus is 494.27 kilograms. The computed average daily waste per person (per capita rate) is 0.53 kg. This value was derived from a 3-day average total waste generation of 494.27 kg per day

3.1.3 Moisture Content Analysis

3.1.3.1 Temperature

In studies analyzing the moisture content of waste through ultimate analysis, temperature is an important factor. This is because temperature directly impacts how much water is driven off from the sample during testing. The higher temperatures cause more water to evaporate, potentially making the waste seem drier than it truly is. This leads to inaccurate moisture content readings. Additionally, high heat can break down organic materials in the waste, releasing more water vapor. This makes it difficult to differentiate between the original water content and the water released through decomposition, further complicating the analysis. Therefore, maintaining a controlled and consistent temperature throughout the process is essential. This ensures reliable and accurate data on the moisture content of the waste sample [28]. The temperature during the study affected how well the solid waste dried, especially during air drying. Study was conducted in Bacolor, Pampanga, and Figure 1 shows the temperature readings. The high average temperature is 32.3 C and heat index of 42%.

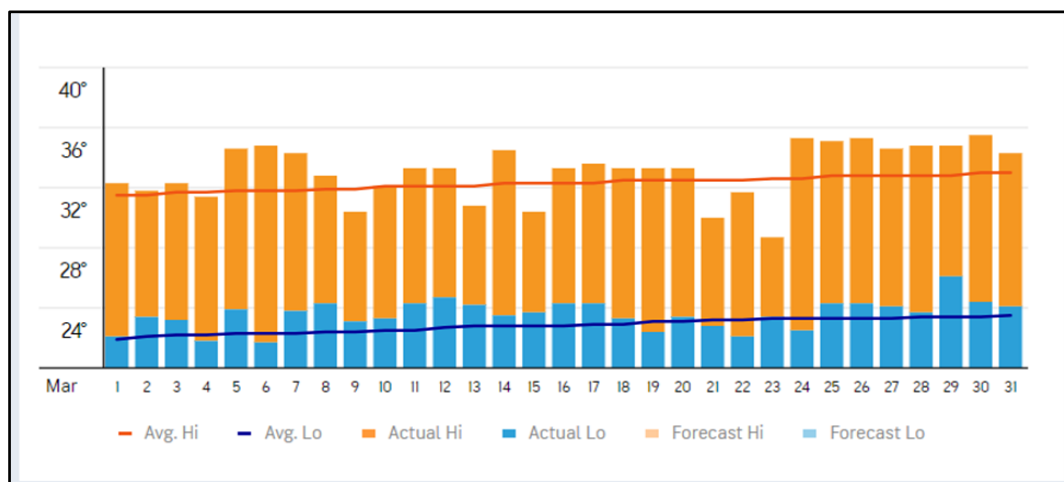


Figure 1. Temperature Profile during Air Drying Process

Source: <https://www.weather-atlas.com/en/philippines/bacolor-weather-march>

3.1.3.2 Moisture Content

The analysis of ten-day waste collected samples found that moisture content has a significant factor in assessing the energy potential of different types of waste materials.

Table 2. Summary of Moisture Content Analysis

Category		Average Gross Weight (kg) Before Drying	Average Gross Weight (kg) After Drying	Moisture Percentage (%)
Paper	Cardboard/ Paper Bags	0.24593	0.20241	17.70%
	Newspaper	0.01573	0.01421	9.66%
	Bond paper	0.29831	0.20393	24.36%
	Magazine	0.00024000	0.00024352	2.7%
	Mixed Paper	0.01470	0.01214	17.41%
Plastic	Pet Bottle	0.49957	0.27447	45.06%
	Polypropylene, Polyesterene Biodegradable Plastic	0.09385	0.07473	20.37%
	Plastic Cup	0.11042	0.07185	34.93%
	Polythelene sac/ Plastic Bag	0.26035	0.20957	5.07%
	Other/ Composite	0.00976	0.00945	3.18%
	Kitchen/ Food Waste	0.07178	0.05894	17.88%

Other Organic	Wood	0.04775	0.03989	16.46%
	Leaves	0.09975	0.09467	5.09%
	Other Composite	0.28400	0.25000	11.97%
Other Inorganic	Rock/ Concrete/ Brick	0.00422	0.00231	45.26%
	Soil/Sand	0.00089	0.00084	5.62%
	Styro/EPS	0.16131	0.12172	24.54%
Total Waste Generated		1.76325	1.14883	
		Total Decreased Percentage		34.84%

The average gross weight before drying was 1.76325 kg, while the average gross weight after drying was 1.14883. The decrease in weight is 0.61442 kg which was used to calculate the moisture percentage. The collected sample waste contained 34.84% moisture which means that significant percentage does not contribute to burning. This aligns with the finding of Garg, Roche, and Matz (2021) findings which found a moisture content ranging from 41% to 60% tend to have a lower heat value when burned [29].

Upon further analysis of the data gathered, differences between waste material types were observed. Cardboard and paper had a low moisture content of 17.17% to other waste materials. This means that this material retains a larger portion of weight during the burning process which results in a high energy output.

Plastics such as PET bottles, plastic bags, and plastic cups can have a higher moisture content, ranging from 45.06% to 34.93%. This higher moisture content significantly increases the energy required for evaporation during the burning process, which also reduces the overall energy output.

Additionally, the moisture content of different organic and inorganic waste categories was quite different. For instance, leaves contained only 5.09% moisture content, compared to 16.46% in wood. Styrofoam, on the other hand, had 24.54% moisture content. Leaves would generate more usable energy during the burning process because of its lower moisture content.

Understanding the moisture content of different types of waste is important for optimizing its potential as a source of energy. Waste with lower moisture content is more efficient in the burning process because less energy is wasted on evaporating water [27].

3.1.4 Calorific Value

The calorific value of the solid waste is a significant factor in assessing thermochemical treatment technologies. The calorific value is indicating the energy stored in a material. To efficiently burn waste and generate energy, it needs a high enough calorific value. Air drying can increase the energy content of solid waste, making it a better fuel. The calorific value measurements, generally expressed in Megajoules per kilogram (MJ/kg). While some studies use calories per gram (cal/g), but MJ/kg is usually used for study purposes [30].

The researchers tested a mixed solid waste sample and a single plastic bottle at a Chemical Engineering Laboratory at the University of the Philippines Diliman, Quezon City. The expectation was for the mixed waste results to detail how the calorific value of different waste types contributes to the overall calorific value. However, the laboratory could only provide and analyze the entire mixed waste sample. For other materials like plastic cups, bags, cardboard, paper (office and mixed), food waste, wood, styrofoam, rocks, and garden waste, the researchers used data from reliable studies since retesting wasn't possible due to laboratory renovations. Therefore, they relied on existing research to determine the calorific value of these individual waste types [31].

In summary, a calorific value, or energy content, of various waste materials. Measured in megajoules per kilogram (MJ/kg), it indicates how much energy is released when burning a kilogram of that material. Plastics, particularly plastic cups at 41.4 MJ/kg, stand out as a good fuel source for waste-to-energy technologies due to their high calorific value [33]. Food waste (13.66 MJ/kg) also offers good potential, while paper products (13.5-15.02 MJ/kg) and wood (14.4 MJ/kg) have a lower energy content. [34][35][36]. Leaves sits in between with a calorific value of 17.84 MJ/kg [37] [38] [39].

3.2 Waste-to-Energy Conversions

Various technologies can transform solid waste into usable energy. However, the choice of technology hinges on the properties of the waste.

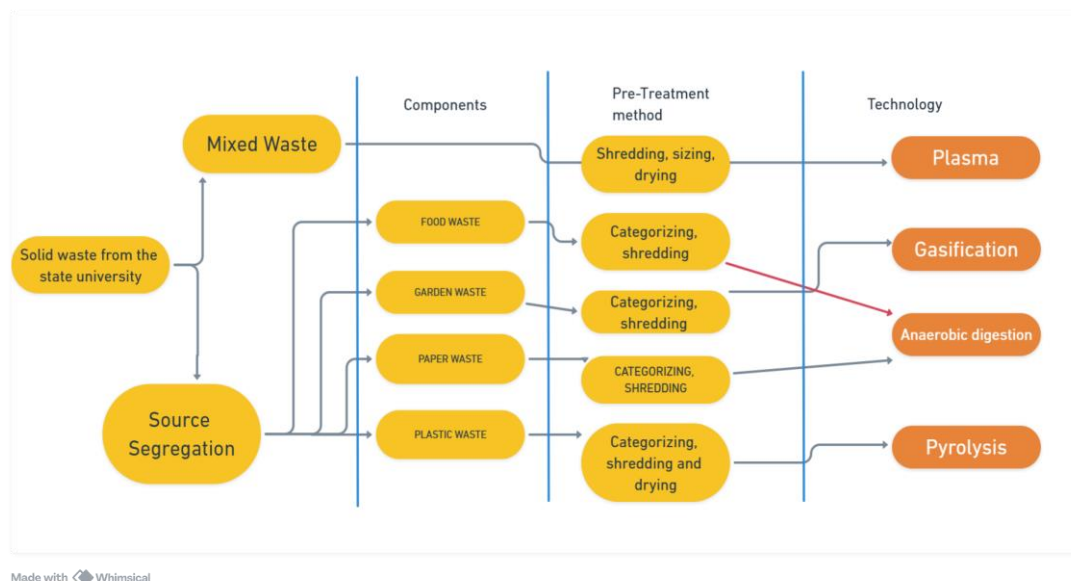


Figure 2. Waste-to-Energy Technologies

Figure 2 includes a comprehensive analysis of the waste, starting with the initial sorting of waste components. Source Segregation with the Food waste, Garden waste and paper waste is categorized and shredded into smaller pieces. Food waste and Paper waste will then proceed to Anaerobic digestion, the Garden waste will go ahead in Gasification. Specific components, such as plastic waste and mixed waste will undergo a drying, categorizing and shredding. Plastic waste will carry on Pyrolysis while mixed waste will undertake Plasma. The components within each class and the pre-treatment technologies applied to process each class is very important; bypassing this method can lead to low operational benefits, increased maintenance, decreased lifespan and worst is failure in WtE systems [38].

3.4 Waste-to-Energy Conversions

Table 3. Summary of Physical and Chemical Composition used in WtE Technologies

Waste Material	Moisture (%)	Calorific Value (MJ/Kg)	WtE Technology	Moisture % requirement	Pre-Treatment method
Mixed Solid Waste	25.25%	26.86 MJ/Kg	Plasma	<50%	-
Plastic Bottle	45.06%	22.53 MJ/Kg	Pyrolysis	<10%	Drying
Plastic Cup	34.93%	41.4 MJ/Kg	Pyrolysis	<10%	Drying
Plastic Bag	5.07%	40.8 MJ/Kg	Pyrolysis	<10%	Drying
Cardboard	17.70%	27 MJ/Kg	Pyrolysis	<10%	Drying
Bond paper	24.36%	13.5 MJ/Kg	Anaerobic	<90%	-
Mixed Paper	17.41%	15.02 MJ/Kg	Anaerobic	<90%	-
Kitchen Food Waste	17.88%	13.66 MJ/Kg	Anaerobic	<90%	-
Wood	16.46%	14.4 MJ/Kg	Gasification	<20%	-
Styro	24.54%	40 MJ/Kg	Pyrolysis	<10%	Drying
Leaves	5.09%	17.84 MJ/Kg	Anaerobic	<90%	-

Plastics, Cardboard and Styrofoam have high calorific values, 22.53MJ/kg - 41.4 MJ/kg particularly effective for Pyrolysis, converting high-calorific plastics into valuable by-products such as synthetic fuels and chemicals to use as energy source. Waste materials like Mixed paper, Bond paper, Kitchen food waste and leaves have 5.09 MJ/kg – 24.36 MJ /kg, a process called anaerobic digestion is better suited for breaking down organic materials with lower heat contents, Paper wastes are richer in cellulose that can be processed through anaerobic digestion to yield biogas [37]. Plasma also requires a high calorific value to operate efficiently, making mixed solid waste to be fit to use as a component in producing energy as it has a heating value of 26.86 MJ/Kg [40].

However, there are moisture content requirement with certain technology. Waste that has less than 50% moisture content can be gasified using Plasma Arc technology [40]. Gasification can handle moisture content without exceeding 20%. Wastes materials for pyrolysis must have a low moisture content—ideally less than 10%. Materials with moisture content of 90% below are processed through anaerobic digestion. The moisture content of the waste materials affects the viability and efficiency of WtE technologies. Drying methods are necessary for the right pre-treatment in order to maximize the efficiency of gasification, pyrolysis, and plasma. Anaerobic digestion is one of the methods that is exempt since it is much more flexible with waste that has a high moisture content. Studies show excessive moisture content, might result in lower efficiency, higher operating costs, and possibly even harm to the technology. To optimize energy recovery and guarantee the longevity and reliability of WtE technologies, the ideal moisture content must be maintained [41] [42].

4. CONCLUSION AND RECOMMENDATION

DHVSU Main Campus faces a growing solid waste management challenge due to its expanding population. The current reliance on external waste bin providers highlights the university's limited in-house waste processing capabilities. To address this, the proposed future plan involves establishing a Materials Recovery Facility (MRF) on an idle lot behind the DHVSU extension. This initiative, in collaboration with relevant stakeholders like the Office of the Planning and Physical Facilities (OPPF), will enable DHVSU to manage waste internally, promoting self-reliance and potentially reducing costs.

These results suggest that WtE technologies hold promise for DHVSU's waste management strategy. There are several methods (think options) for converting waste into energy, each with its own pros and cons. The best choice depends on what kind of trash DHVSU throws away the most (waste composition), what kind of energy they want to get (heat, electricity, or fuel), and of course, how much it will cost. Some methods, like plasma, incineration, gasification, and pyrolysis, use high heat to turn waste into usable energy. Another method, anaerobic digestion, uses tiny organisms to break down organic waste and create biogas, a type of fuel. To pick the best option for DHVSU, researchers need to carefully consider what kind of trash should have and what kind of energy should need. It might also need to sort their trash beforehand (pre-treatment) to make these conversion processes work even better.

By implementing a system that both sorts trash (MRF) and potentially converts some of it into energy (WtE), DHVSU can become much more eco-friendly. This would not only help them deal with their growing waste stream but also potentially create usable energy, reducing their reliance on traditional sources and promoting environmental responsibility within the university community.

The University can explore some innovative technologies for converting waste to energy, like plasma gasification, pyrolysis, and anaerobic digestion. By finding a solution that fits the amount of waste they produce, DHVSU can make the most of their trash and make it beneficial.

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