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INVESTIGATION OF WASTE MANAGEMENT IN REGARDING CHEMICAL CHARACTERIZATION OF WASTE STREAM

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Abstract

Especially in developing countries, the indecorous management of solid waste poses a significant threat to human health and ecosystems, flora, and fauna. the volatile and non-volatile substances were determined using percentages of the original mass. pH and Conductivity were measured by pH meter and conductivity meter. Using the flame photometric procedure, potassium, phosphorus, nitrogen, alkalinity is estimated. Results depicted that EC values were higher in pre-monsoon season's primary collection samples and lower in monsoon season's temporary collection samples and treatment site samples. TOM was higher in the winter season primary and secondary collection samples and lower in pre-monsoon primary and secondary collection samples. Sodium content was minimum in the summer collection samples and maximum in the winter. The improper disposal of solid waste leads to the obstruction of drainage, which in turn causes a disagreeable odour, inundation, and an unappealing appearance on the surface of the receiving water body.

Keywords: Waste stream, Chemicals, Characterization, Seasons

1. Introduction

The accumulation of Municipal Solid Waste (MSW) in India has substantially increased as a consequence of the country's rapid population growth and lifestyle changes (Priyadarshini and Abhilash, 2020). It encompasses both domestic and commercial waste, which constitutes a relatively minor portion of the total solid refuse discharge in developed countries (Kumar and Agrawal, 2020). Numerous complications may arise for the inhabitants of an area as a result of the accumulation of a substantial quantity of refuse (Cho et al., 2020).

The physical and chemical characteristics of organic solid waste are heterogeneous in nature (Arya and Kumar, 2020). These includes solids (TS), biomethane potential (BMP), total nitrogen (TN), and total phosphorus (TP), as well as moisture content and refuse particle size (Ren et al., 2021). The organic waste is biodegradable and is primarily derived from agricultural or culinary refuse (Gupta et al., 2015). The composition of these waste materials varies among municipalities, regions, and countries (Goel, 2017). Its composition is influenced by a variety of factors, including living standards, geographical locations, the cultural preferences of individuals, the type of habitation, and the seasons (Singh, 2020). The objective of the study is to assess the waste in regarding chemical characterization of waste stream.

2. Material and Method

Volatile Substance and NonVolatile Substance: Determine the volatile and non-volatile substances as percentages of the original mass using the following formula:
Volatile substance, percent by mass (VS) = Initial mass − Final mass Initial mass X 100 Non - volatile substance, percent by mass = 100 - VS.
Determined on a dried sample taken from the moisture content test and then heated to 600˚C for 2 hours in muffle furnace. The weight loss represents the volatile solids expressed as percentage of dry solids (IS:10158 1982) Determined with the help of mathematical expressions shown below:
Total solids (%) = 100 -Moisture content (%)
Ash content (%) = 100-Volatile Solids (%)
Using pH meter's The pH reading was recorded.
The conductivity cell was directly immersed in the suspension to measure conductivity.
The alkalinity of phenolphthalein was determined by accounting for the volume of HCl that was introduced.

Using the flame photometric procedure, Sodium, potassium is estimated. The intensity of the characteristic radiation is directly proportional to the concentration of potassium and can be monitored at 766.5 nm using appropriate filter devices.
The sample's organic matter is decomposed by an excess of sulphuric acid and potassium dichromate. This method only recovers approximately 60-90% of the total organic matter.
Kjeldahl nitrogen is the sum of ammonia nitrogen and organic nitrogen. All soil nitrogen, with the exception of nitrates, is determined by this procedure, including assimilated NH_4^+.

3. Result and Discussion

3.1 Volatile Content

The estimated volatile content was higher (46.185%) at the primary collection sample and lower (9.132%) at the disposal site sample, as illustrated in the graph (Figure 1). Volatile substances also play a significant role in gas formation.

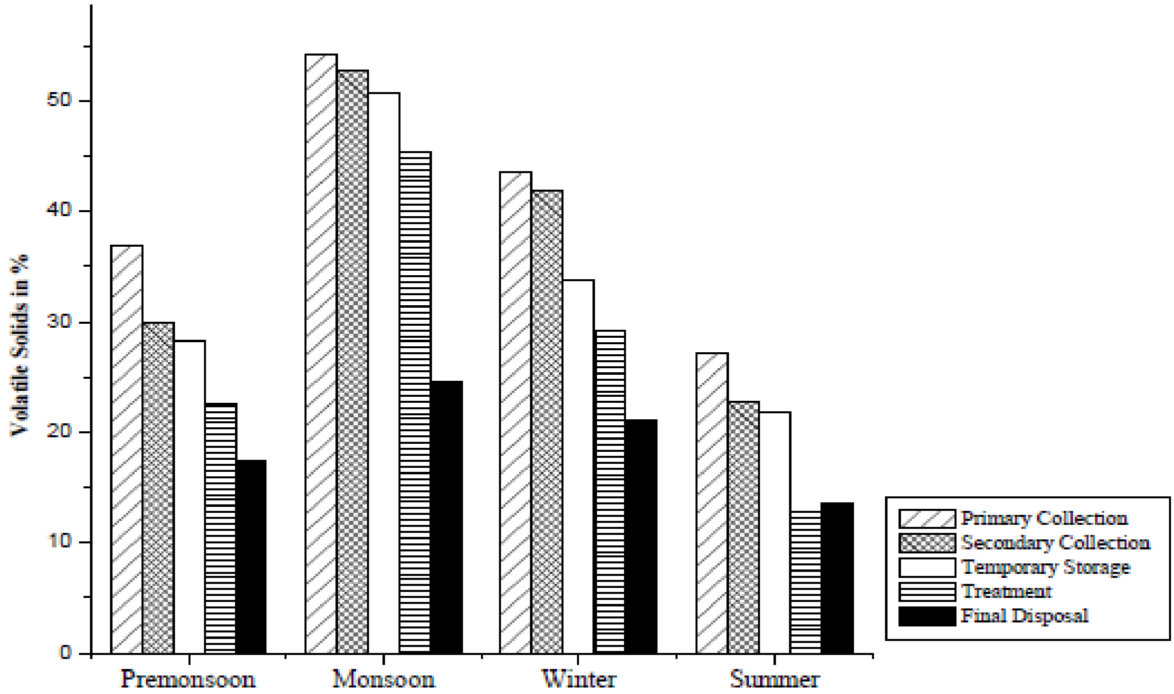

Figure 1 Volatile Solids %, waste stream analysis in seasons (Average)

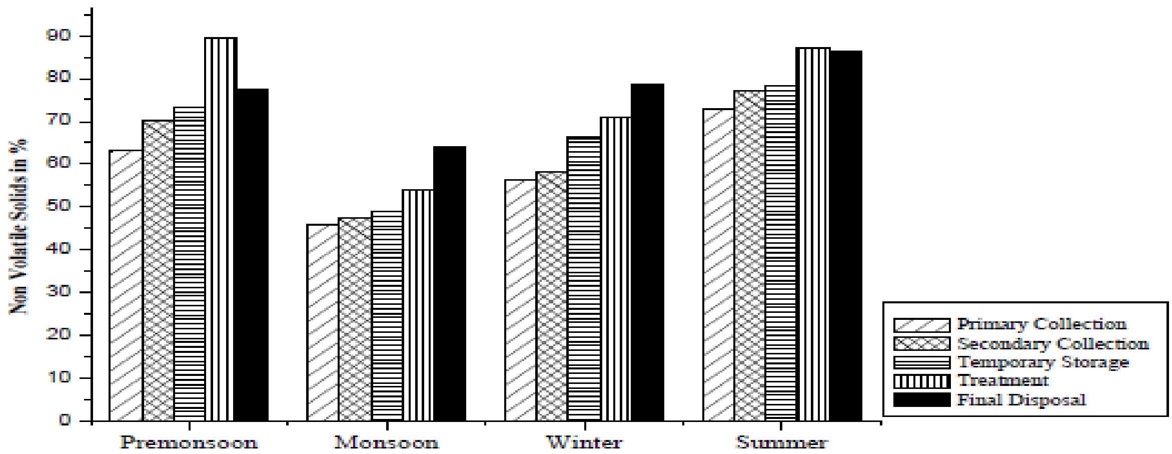

Figure 2 Non-Volatile Solids %, waste stream analysis in seasons (Average)

3.2 pH

The graph (Figure 3) illustrates that all of the samples collected during the summer had a mildly alkaline pH within the range of 7.08–9.33. The methane produced through the fermentation process of breakdown raises the pH to a more neutral level by converting acids and hydrogen ions to carbon monoxide and methanol.

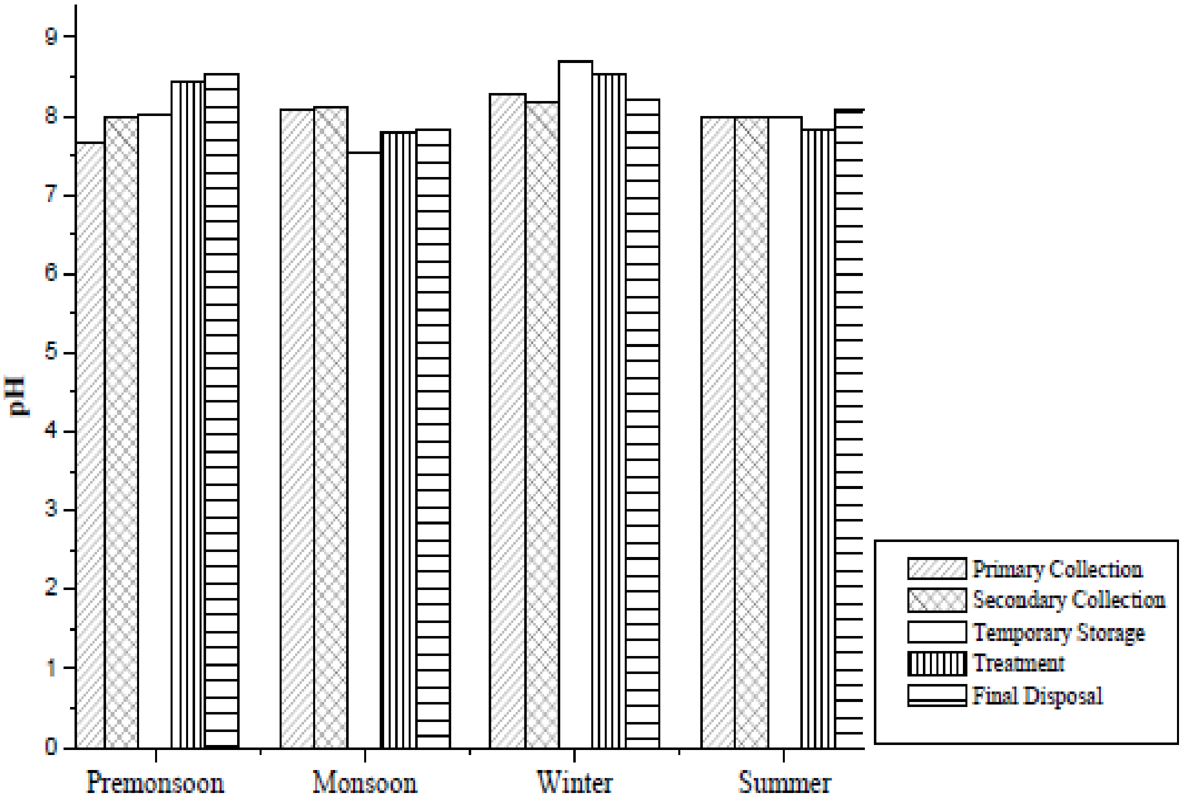

Figure 3 pH, waste stream analysis in seasons (Average)

3.3 Electrical Conductivity (EC)

The minimal and maximum EC values in the waste stream analysis were as follows: 1.33–9.99, 2.96–7.30, 3.42–5.06, 4.21–4.52, and 4.76–5.18 m mho. cm−1 (Figure 4.1).

The degree of salinity and mineral compounds in the waste is indicated by the electrical conductivity, which is typically influenced by the total quantity of dissolved organic and inorganic materials in the solution. The intensity and overall pollutant burden of the waste are further reflected in the total mineral content (Mani and Singh, 2016).

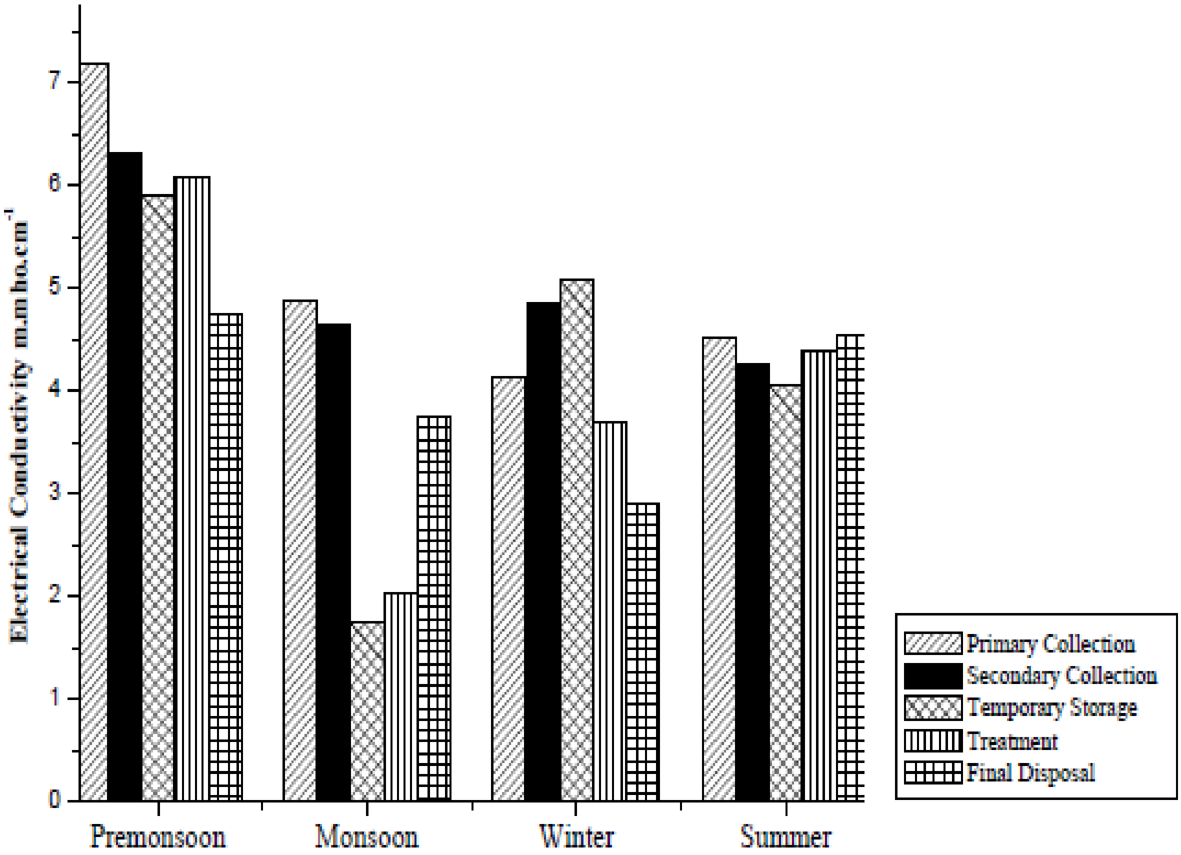

Figure 4 Electrical conductivity, Waste stream analysis in seasons (Average)

3.4 Total Alkalinity

Carbonate, bicarbonate, and hydroxyl ions are the sources of alkalinity. Dissolved carbon dioxide is the primary component of alkalinity, and the biodegradation process of organic matter within the waste mass results in the production of a substantial quantity of bicarbonate. Figure 4 illustrates that the total alkalinity value of the waste stream is 12,50-50.00, 12.50-37.50, 25-37.50, and 25-37.50 (meq/100g) during the summer season. The ultimate disposal contains 25.00-37.50 (meq/100g).

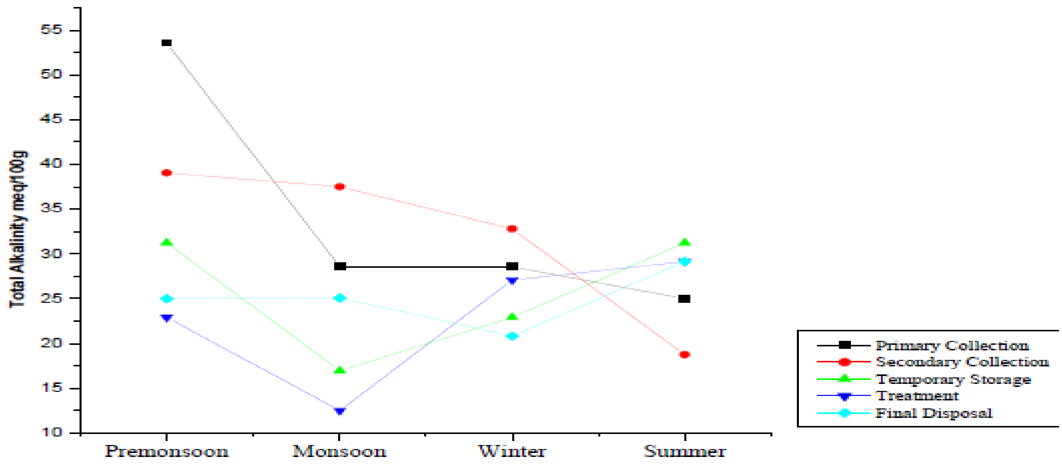

Figure 5 Total Alkalinity, waste stream analysis in seasons (Average)

3.5 Nitrogen, Phosphorous, Potassium, Sodium and Carbon

The exposure of refuse in the open place for windrow decomposition resulted in a minimum amount of nitrogen (Figure 6), phosphorous (Figure 7), and potassium (Figure 8) in the transient storage, treatment site sample, and ultimate disposal samples.

The minimum and maximum percentages of sodium were 0.0764% and 0.3204%, respectively, and the carbon percentage was 7.60% and 45.59%. The graph (Figure 9 and 10) illustrates the values derived in the waste stream and the allowable limit of sodium and carbon.

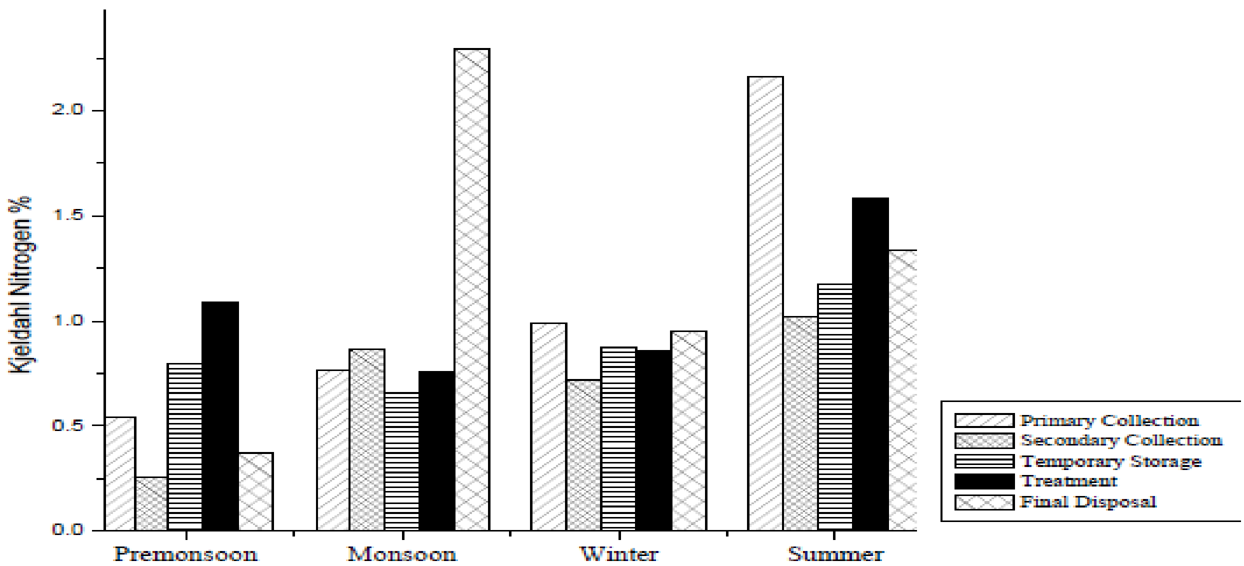

Figure 6 Kjeldahl Nitrogen, waste stream analysis in seasons (Average)

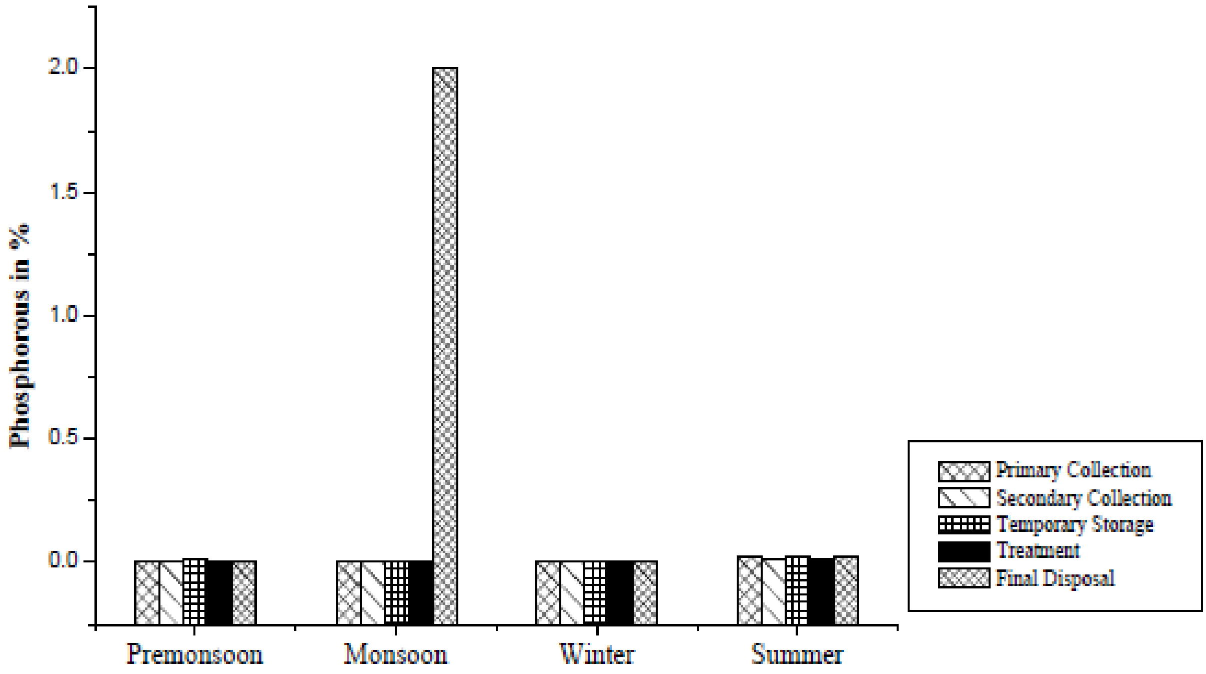

Figure 7 Phosphorous %, waste stream analysis in seasons (Average)

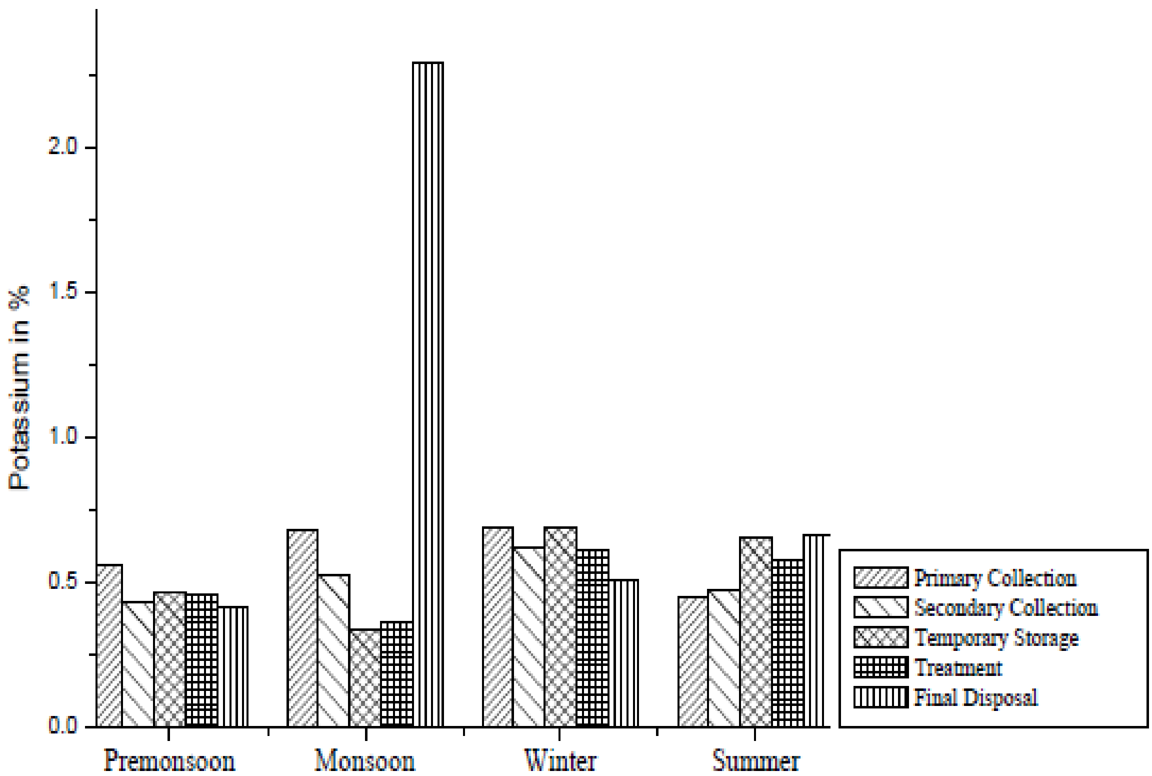

Figure 8 Potassium %, waste stream analysis in season (Average)

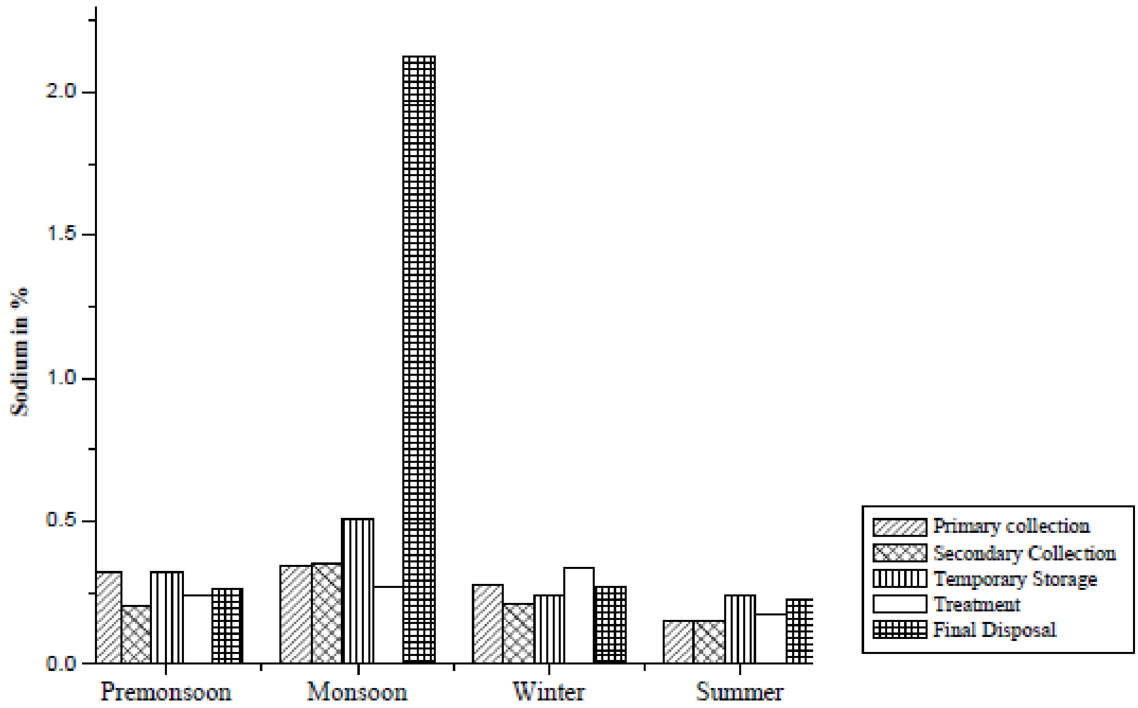

Figure 9 Sodium in %, waste stream analysis in seasons (Average)

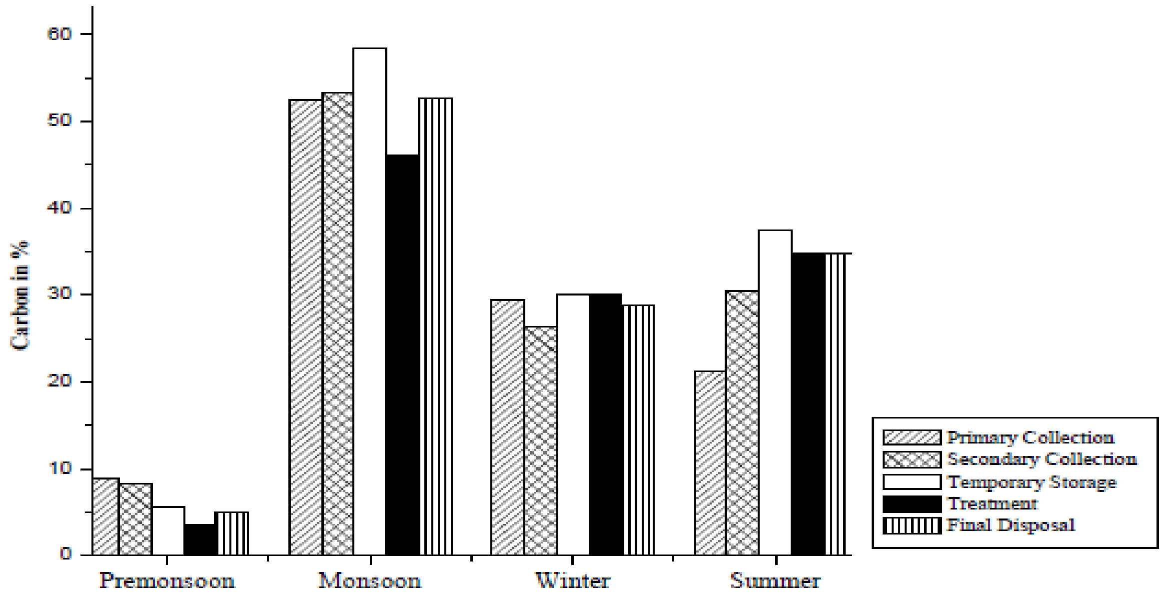

Figure 10 Carbon content, waste stream analysis in seasons (Average)

The concentration of nitrogen in MSWC (compost) has been observed to increase as the decomposition process progresses, as microorganisms utilise carbon. According to Zorpas (2020), the concentration of P in soil increases as the application rate increases, indicating that MSWC effectively supplies Phosphorus.

3.6 TOM

The TOM measurement (37-47%) suggests that there is an adequate quantity of TOM to produce compost. The TOM can be further enhanced by incorporating sewage sediment or horticultural detritus into MSW. According to Singh, (2020), MSWC enhances the water-holding capacity of soil and enhances its buffering capacity. The present study demonstrated that TOM exceeded the permissible limit at all phases of refuse travel, with only a small number of samples falling within the limit, as illustrated in the graph.

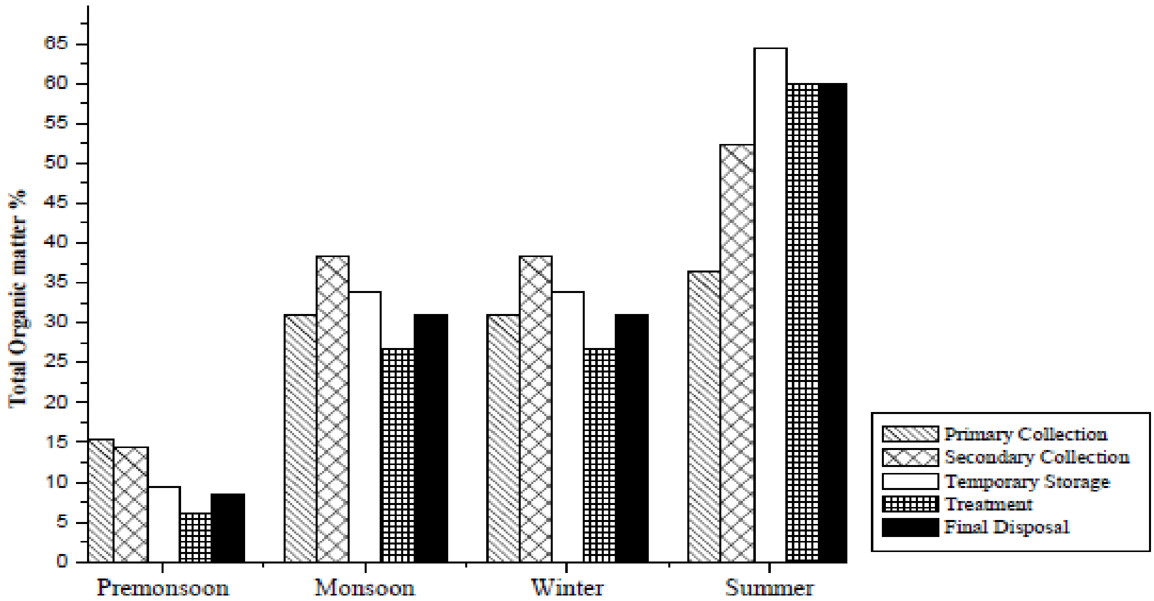

Figure 11 Total Organic Matter, waste stream analysis in seasons (Average)

From the seasonal characterization study, the percentage of moisture content was higher in all the stages of waste travel in the winter season and in the summer season the percentage of moisture content was lower. The volatile content of monsoon season was higher than the other seasonal samples and the reverse was observed in ash content (non-combustible residue). There was no remarkable variation in the pH for all the four seasons (acidic and alkaline). The percentage of phosphorous was higher in the pre-monsoon, and slightly lower in monsoon, winter and summer at all the stages of waste travel. The percentage of nitrogen and potassium shows no remarkable changes in all the four seasons (Figure 4.8 and 4.10). The carbon percentage was least at pre-monsoon season and it was found to be almost similar in all the other seasons as shown in Figure 11.

4. Conclusion

Anthropogenic activities generate a substantial amount of refuse in a variety of forms, to the detriment of all forms of life on Earth, including humans. Consequently, environmental sustainability, protection, and prevention depend on effective management of municipal solid waste. This research looked at the physical and chemical compositions of MSW, including how they change with the seasons. These include things like pH, thermal conductivity, total alkaline content, total organic matter, amounts of carbon, calcium, magnesium, phosphorus, calcium Kjeldahl nitrogen, the latter of total solids, total solids, solids with volatile compounds, and not volatile, solid materials.

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