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Segregation Techniques for a Municipal Dump Site at Parakadavu; Based on its Quantity, Composition and Effect on Water

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Abstract - *Proper municipal solid waste management has become a challenge, not only due to environmental and aesthetic consideration, but also due to the massive amounts of municipal solid waste (MSW) generated every day. This paper deals with the detailed study of dump site at Parakadavu, which is located at Thodupuzha municipality, in Idukki district, Kerala. This paper involves the determination of composition of MSW in dump yard, its effect on surrounding water sources, and the method to dispose the legacy waste from the dumping yard. Several water quality tests were conducted by collecting samples from nearby wells. Parameters such as pH, acidity, alkalinity, chloride, iron, conductivity, turbidity, total dissolved solids were examined to assess water quality. The total quantity of waste in dump yard is determined using total station. Based on the study conducted a proper segregation technique is formulated which involves the usage of trommel, and magnetic separator to segregate the waste and to make the dump site cleared*

Key Words: dump site, composition, water quality tests, segregation techniques, Refuse Derived Fuel (RDF)

1.INTRODUCTION

Effective waste management at dumping sites, such as the one located in Parakadavu within Thodupuzha municipality, is essential to mitigate environmental degradation and safeguard public health. Accumulated solid waste over time poses significant risks of contamination and health hazards. Conducting waste characterization studies is imperative to understand the composition of waste and its potential impact. Through methods like hand segregation, samples are analysed to determine the percentage of each waste component for further assessment. Additionally, assessing the water quality of nearby water resources is crucial to evaluate pollution levels and potential hazards. Various tests and evaluations are conducted to ascertain the extent of contamination and its effects on human health. Proposed segregation techniques aim to prevent further contamination of water resources. By implementing comprehensive segregation strategies integrated into waste management systems, communities can achieve more sustainable practices, thereby contributing to a healthier and more environmentally friendly future.

1.1 Objectives

- To study the characteristics and to determine the composition of waste in dumpsite
- To study the effect of dumpsite on local surrounding water sources
- To determine the quantity of waste and to formulate a segregation technique for dump site

2. METHODOLOGY

- Study of Dump Site
- Determination of Composition
- Water Sample Testing
- Calculation of quantity of waste and formulation of segregation techniques

3. STUDY OF DUMP SITE

The dump site is located at Parakadavu, in Thodupuzha municipality, Idukki district, Kerala. This region has a climatic profile that includes heavy rainfall, high humidity and a relatively constant temperature (23-32 degree Celsius) throughout the year. The dumpsite occupies a total area of 1.26 acres, with 80 cents of this space filled with dumps.
For the last 40 years Thodupuzha municipality's solid waste has been deposited in the dumping yard at Parakadavu. The waste is dumped from ground level to maximum height of 15.28 m.

Fig -1: Location of Dumpsite

4. COMPOSITION OF SOLID WASTE

4.1 Collection of Off-Field Data

In order to gather comprehensive information about the dump site, we embarked on a process of collecting details from both local inhabitants and government bodies. Engaging with the local community provided valuable insights into the history and characteristics of the dump site, including patterns of waste disposal and community concerns. Concurrently, liaising with government agencies and relevant authorities allowed us to obtain official data regarding the dump site's status, regulatory oversight, and any ongoing management initiatives. By synthesizing these diverse sources of information, we were able to generate a general understanding of the dump site's location, size, composition, and potential environmental impact.

4.2 Sample Planning and Collection

With a solid foundation of off-field data, we proceeded to plan and execute the sampling process. This involved careful consideration of several factors, including the weight and number of samples to be collected and the selection of suitable locations for sampling. After deliberation, we determined that a sample weight of 5 kg and five iterations would be appropriate to capture the variability of waste composition across the dump site. Utilizing our knowledge from off-field data collection, we identified ideal spots within the dump site for sample collection, ensuring representative samples were obtained.

Fig -2: Dump Site, Parakadavu

4.3 Analysis

Upon successful collection of samples, our analysis phase commenced. The samples (S1, S2, S3, S4, S5) were subjected to hand segregation to separate them into different components, facilitating a detailed examination of their composition. Subsequently, each component was weighed to quantify its proportion within the sample. Finally, we formulated results for analysis, synthesizing the data obtained from sample collection and segregation to derive insights into the waste composition and characteristics of the dump site. This analytical procedure was a pivotal stage in comprehending waste disposal dynamics and devising efficient management approaches. Others include sanitary waste, wood, and aggregate materials. The obtained data are given below

Table- 1: Composition

Parameters	S1 (%)	S2 (%)	S3 (%)	S4 (%)	S5 (%)
Organic matter	79.7	82.1	81.22	77.82	80.24
Plastic	11.2	8.93	10.02	10.46	9.74
Glass	1.24	0.92	1.1	1.02	0.86
Metal	0.84	1.67	0.42	1.94	1.38
Paper	4.28	3.88	4.42	4.34	6..02
Electronics	0	0.6	0.24	0.68	0
Others	2.74	2.54	2.76	3.74	1.76

Through the analysis of composition, it has been found that about 80% of the dump constitute organic matter. Similarly, about 10% constitute plastic. Glass, metal, paper, electronics, etc. constitute the remaining10 percentage. The presence of electronics is less identified during segregation

5. WATER SAMPLE TESTING

The deterioration in the quality of water due to the presence of dumpsite should be verified using the various testing of parameters of water. To assess water quality, five water samples were gathered from five distinct wells surrounding the dump site to identify any fluctuations in water quality. For collecting samples, one-liter high-density polyethylene bottles were utilized, and precautions were were taken to prevent contamination. In laboratory, tests such as acidity alkalinity, pH, chloride, electrical conductivity, iron, total dissolved solids, turbidity were conducted for all five samples. The samples (S1, S2, S3, S4, S5) were gathered and analyzed three times, with each testing session spaced 15 days apart. Three to four iterations were carried out for each of the samples for accuracy. The test results are shown in Table 2. The test results clearly show the contamination of water sources due to the dump site. The presence of contamination is because of the infiltration of contaminants from dumping site to ground water which affect the quality of wells, further it may lead to significant health risk for individuals and also destroy the surrounding ecosystem.

Table- 2: Groundwater Parameters

Parameters	S1	S2	S3	S4	S5
pH	5.61	6.13	6	6.36	6.08
Iron (mg/l)	0.057	0.37	0.51	0.21	0.63
Chloride (mg/l)	8.66	3.82	23.62	7.32	3.49
Alkalinity (mg/l)	25.3	19.3	19.3	76	102
Acidity (mg/l)	46.67	36	34.67	51.33	45.33
Turbidity (NTU)	6.03	11.33	10.5	13.33	14.41
Conductivity (µs/ppm)	355.03	434.67	677.3	452.87	586.17
TDS (mg/l)	59.47	93.27	150.46	173.97	136.13

The results are compared with IS 10500:2012 standards. It is found that the results obtained from the study area are some within the limits and some are not. It is mainly due to the pollution from dump site. The profile of the dump site is in such a way that there is a higher possibility for leachate to enter into the ground water and contaminating them. All the water samples are acidic in nature. That is their pH is less than 7. It its self-shows that the water is not suitable for drinking. Most of the sample shows iron content more than its limits and the presence of chloride is also identified. All the samples exhibited mineral acidity, rendering them unsuitable for drinking. Consumption of water with mineral acidity can cause higher health issues as well as it inversely effects aquatic life, and results in soil degradation also. Everything strongly shows that there has been a contamination due to the dump site. So, it is very needed to replace all the waste from the dumpsite in an effective way.

6. SEGREGATION TECHNIQUE

Prior to devising a segregation strategy, we ascertain the quantity of waste at the dump site using total station. The quantity of solid waste in dump site is measured using reduced level obtained from total station. At the initial phase in the dump yard, the entire plot was divided into different part using a 2-meter grid. Point of intersection on grid is plotted and marked on ground. A combination of total station and levelling staff is used for finding the reduced level of surface of dump site at different marked points, all necessary readings like fore site, back site and reduced level are recorded. This recorded value is used to find area of sections on the grid. The area calculated is used to find quantity of total solid waste in dump yard. The quantity of waste was found to be 26640 m^3.As the quantity of solid waste have been determined using surveying technique and its composition using hand segregation. General physical characteristics of the dump site is identified. This characteristic can be used to identify other dump yard with similar properties and effective techniques used to segregate solid waste. During the study we found two dump sites with similar waste characteristic in Kottayam-vadavathur and in kollam. Segregation techniques employed in this two-waste disposal site is studied for formulating an effective technique.

First procedure is predicting the quality of recycled waste to formulate an economical segregation technique. During determination of composition, it was found that recyclable plastic and paper obtained will be mixed and of low quality due to contamination by decomposed organic waste hence they have very low economic value and can only be used as refuse derived fuel (RDF). Metals obtained are recyclable and can be recycled through venders. Glass materials don't get degraded by other wastes hence can be recycled, inert materials like large boulders and concrete block obtained (C&D) after segregation does not lose its strength and hence be recycled.

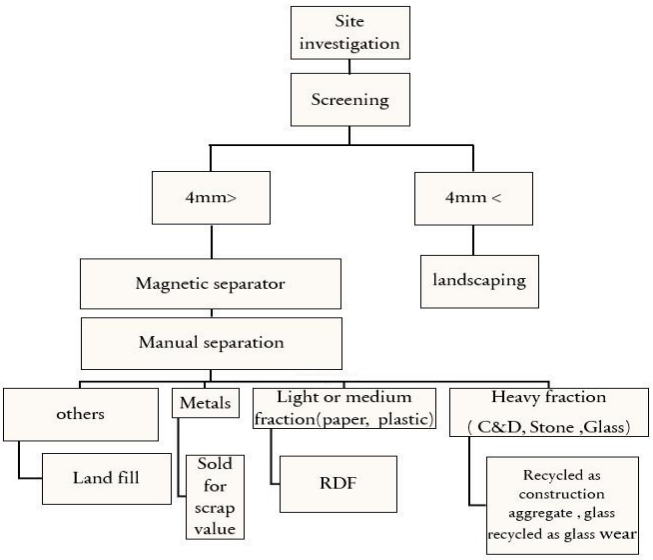

Fig -3: Segregation Technique

Based on the study conducted on dump site in Thodupuzha and other dump site, we have formulated a segregation technique as followed. Initial phase of all dump sites in the world is decomposition of organic solid waste which reduces the quantity of organic component. In Parakadavu dump site during the determination of composition we have found that the organic contents have been completely decomposed thus the bioremediation and activated decomposing procedures can be eliminated. Further studies showed the site was inactive for long six months, which confirms the preceding conclusions accuracy, keeping all economic and environmental factors the designed segregation technique is as followed. First phase is the separation of organic content from solid waste, accomplished by using a trommel with rotating 4 mm bar screen. This effectively separates organic content from the solid waste. Large and inert materials are separated by hand picking then the solid waste loaded into rotating trommel using backhoe loaders. Decomposed organic content get separated. Around eighty percent of waste is decomposed organic materials, thus large part of the waste is segregated in the first stage itself.

Second phase is the separation of valuable metals from solid waste using magnetic separator. With the completion of first two steps quantity of waste get reduced to 15 percent of its initial quantity. Third phase is the manual separation of remaining waste. To separate it into glass, inert large particles, plastic and paper. Expensive machines can separate between different grades of plastic but hand segregation is preferred at Parakadavu due to low or no economic value for contaminated plastic and has a very small quantity of solid waste remaining after first two stages of segregation, that is around 4000-meter cube. Paper and plastic is bailed using bailing machine, which can be sold to manufacturing plants using RDF as fuel.

7. CONCLUSIONS

The investigation into the groundwater quality surrounding the Parakadavu dumpsite has revealed indications of contamination, primarily due to waste water seepage. This contamination poses a threat to the nearby ecosystem. To counteract these adverse effects, a segregation method has been devised, considering factors such as land availability, technological feasibility, and economic viability. The optimization process commenced with determining the composition of solid waste through manual segregation over five representative sampling iterations. Subsequently, a total station survey was conducted to quantify the solid waste. Using the gathered data, an efficient segregation method was formulated, incorporating a combination of trommel, magnetic separator, and manual segregation techniques, supported by heavy earth-moving equipment and personnel. This holistic strategy seeks to oversee and reduce the environmental footprint of the Parakadavu dumpsite, protecting the nearby ecosystem and advocating for sustainable waste management methods.

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