Characteristics of Raw Leachate of Jeram Sanitary Landfill

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Abstract
A study on the characteristics of the raw leachate of Jeram Sanitary Landfill (JSL) had been carried out for 5 months. Twenty samplings were carried out to define differences in leachate characteristics during operation on sunny and rainy days. The water quality of leachate produced by the two conditions can be compared with the quality of the design parameters of the treatment plant. During the sunny days sampling, average water quality characteristics for temperature, pH, COD, DO initial, BOD, TSS, and TDS are 28.73^{0}C, 7.35, 1168.96, 8.41, 657.55, 44.38, 938.17 mg/l, respectively. For rainy days sampling indicates that the quality of the water has improved these were in the pH, COD, DO initial, BOD, TSS, and TDS are 27.83^{0}C, 7.35, 598.54, 8.32, 318.15, 37.08, and 614.20 mg/l, respectively. In contrast, the raw leachate quality in the rainy season is much worse than in the dry season.

Keywords: water quality, raw leachate, sanitary landfill

1.0 Introduction

Most landfill sites in Asia are in a monsoon climate. Climatic conditions in tropical countries such as Thailand, Malaysia, etc. can be characterized by rainy and sunny days. There is high-intensity rainfall (up to 80 mm/day and above) the wet season while the dry season does not have rainfall. It has been observed that 220 - 250 days per year shows no rain at all, and there is a distinct arid period of about 4 months. With a medium temperature of 28˚C and an average sunshine duration of 6.8 hours, solar radiation is computed to be 18.8 MJ/m^2/day. Climatic variation can significantly affect the leachate quantity and quality (Visvanathan et al., 2002). During sunny days leachate and gas production nearly stops and restarts immediately with the merge of the rainy season (Ranaweera, 2001).

Effects of tropical climatic correlation with leachate characteristics were studied by Trankler et al., (2005) and Tubtimthai (2003). Generally, Malaysia has two distinct seasons. The dry season occurs during the southwest monsoon from May and September. The northeast monsoon brings the rainy season to the country from mid-November till March. However, reality conditions of seasonal variation were observed in this study for determining the relationship of weather condition and leachate generation, leachate characteristics, etc. (Haliza, 2011).

After comparing and interpreting all the findings, it was determined that (Trankler et al. 2005) had an impact on leachate formation and quality.

i. Climate (wet and dry seasons): Rainfall patterns influence leachate formation. Because there is less or no leachate formation, less cumulative leachate, and stagnant discharge during the dry season, there is little or no precipitation. During the wet season, when there is usually a lot of rain, there is higher leachate production and accumulation than during the dry season. Furthermore, variations in leachate properties were discovered in relation to breakdown phase and rainfall pattern.
ii. Top cover layer design (standard cover, alternate cover, or no cover): due to excessive water infiltration, the open dump had just a thin sand cover, resulting in high leachate generation.
iii. MSW input properties (pre-treated waste, MSW compaction, arriving MSW moisture content, etc.): pre-treated waste by composting has the lowest COD concentration and loading. The open cell lysimeter, on the other hand, produced the greatest COD (20 percent and 180 percent, respectively, more than sanitary landfill lysimeter).

The production of leachate is unavoidable disposal of solid waste in sanitary landfills. It is the consequence of rainwater percolating into the trash, extracting and transporting numerous dissolved and suspended pollutant elements. The composition of sanitary landfill leachate is quite complicated and is mostly determined by the type of solid wastes deposited, environmental circumstances, and the age of the sanitary landfill. Inadequate leachate management poses significant concerns, including contamination of water resources (surface and groundwater), as well as soils.

2.0 Scope of Work

Leachate quality can be assessed from both laboratory studies and field studies. Laboratory leachate tests may be performed. In addition, (if feasible), leachate samples should be analyzed from existing waste dumps or landfills near the new site. This will help in a leachate treatment strategy.

Before the main design of a landfill can be undertaken it is important to develop the operating methodology. A landfill is operated in phases because it allows the progressive use of the landfill area, such that at any given time a part of the site may have a final cover, a part being actively filled, a part being prepared to receive waste, and a part undisturbed.

3.0 Leachate Quality

Design for raw leachate quality is determined by considering cases of water quality analysis at other sanitary landfills that are having relatively similar waste compositions and the landfill structure. The active life of the pond system represents the period in the landfill life during which maximum leachate can be expected. This is when the landfill is open (prior to placement of final cover) and is actively receiving waste in its two-cell life cycle.

During the wet season, rain falls in brief bursts, however during the monsoon season, storms and severe rains can linger for days. It is critical that sufficient rainwater drainage systems, as well as adequate leachate collection and retention facilities, are included in the landfill design. In order to prevent rainfall from infiltrating the layers, additional waste surface cover may be

required. On the cover surface, a suitable drainage network system must be installed to collect and redirect rainwater to the perimeter storm water drains. Excessive rain can also cause flash flooding and soil erosion.

There may be periods of time during the dry season when there is no rain, and the grounds and earth roads might become exceedingly dry and dusty. It's critical to keep an eye on the activities of placing the cover dirt, the wind conditions, and vehicle movements to ensure that airborne dust is kept to a minimum. Spraying water on dry roads may be necessary to dampen the dust and prevent it from becoming airborne.

4.0 Methodology

The basis of this study was conducted through literature reviews. The literature review offers perspectives on the characteristics of raw leachate. Further analysis of data collection is required in order to achieve the objectives mentioned previously. The approaches laboratory analysis of leachate characteristics i.e., pH, Total dissolved Solid (TDS), Total Suspended Solid (SS), initial Demand Oxygen (DO), Biological oxygen demand (BOD), and Chemical oxygen demand (COD) also determined. The analysis was based on the Standard Methods for the Examination of Water and Wastewater.

Measurement of the leachate production should depend on the following:

I. Climate conditions
II. Existing meteorological information
III. Amount and frequency of rainfall
IV. Amount of the total daily waste
V. Design capacity of treatment plant

In places with seasonal leachate volume fluctuations (for rainy days or sunny days), the facility must be designed so that multiple facilities can operate in parallel during peak volume season while some of the facilities can be temporarily shut down during low volume season. When calculating the size of the treatment facility, preliminary measurements on flow volumes through hydrogeological surveys in a potential landfill site must be made. The water flow mechanisms in the flow areas must be investigated and comprehended. All this information can be used to plan a liner facility or a collection and discharge system for underground water.

4.1 Raw Leachate Sample

The samples were collected periodically from the landfill. The samples were taken from a predetermined discharge point where the samples represent the liquid generated from three main pipelines in the area currently in operation. The pre-treated leachate samples were concurrently obtained from the effluent. The wet samples were collected when raining at the landfill. The samples were collected in 2 litre bottles, transferred to the laboratory, and stored at 4◦C. Sampling was continued for 5 months between November and March.

Raw leachate sample was measured and analysis was based on the Standard Methods for the Examination of Water and Wastewater. The sample was takes 1 time per week depending on climate and the leachate characteristics i.e., temperature, pH, total dissolved solids (TDS), total.

suspended solids (TSS), initial dissolved oxygen (DO), chemical oxygen demand (COD), and biochemical oxygen demand (BOD) also determined. The raw leachate can be taken at the point 1 pump station on site on rainy and sunny days. Point 1 pump station is the end outlet of overall leachate production of the site (Figure 1). Each test was performed at least 3 times to confirm the reproducibility of experimental data

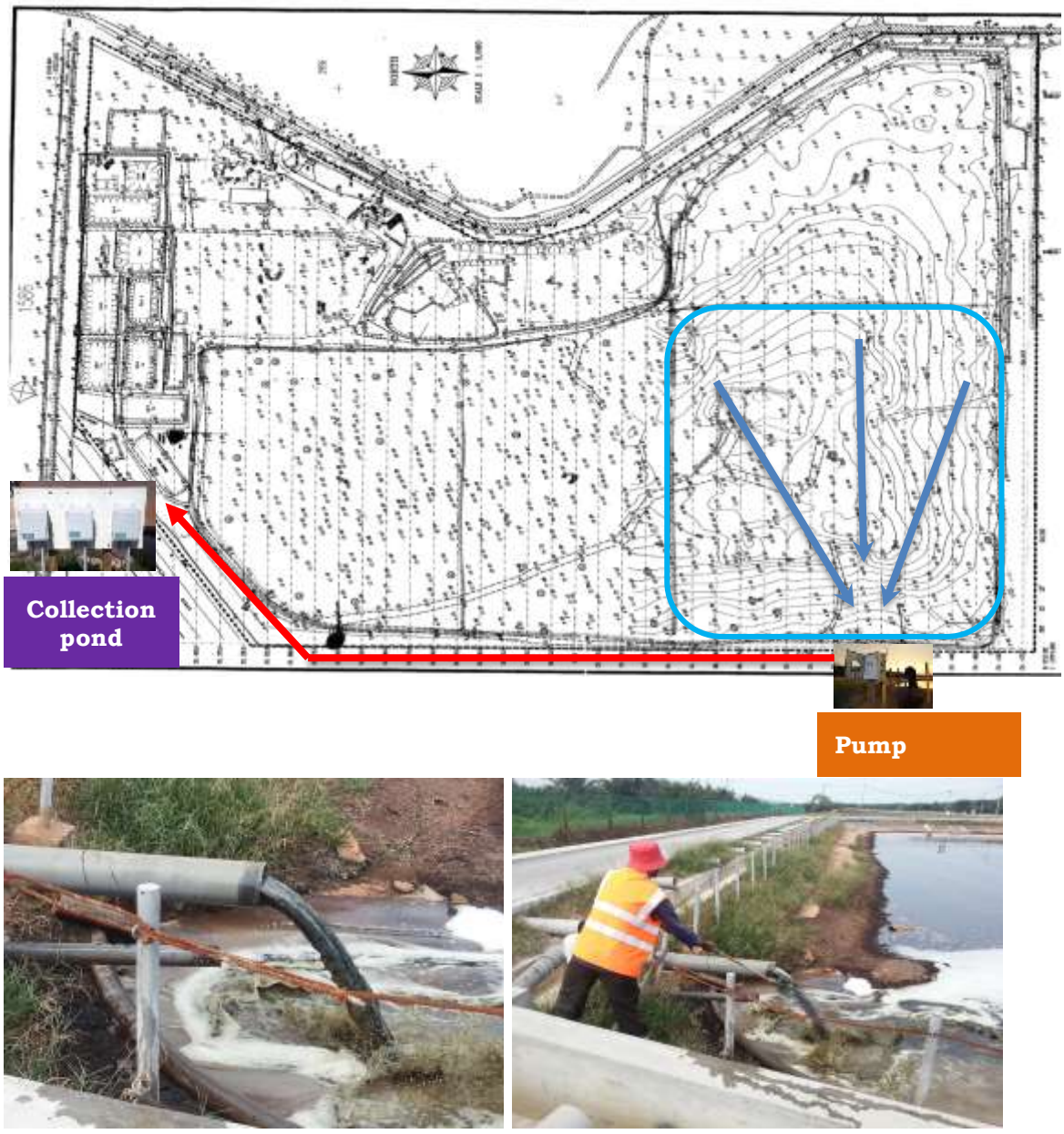

Figure 1: Collection of Sample

4.2 Data Analysis

Estimation and observation leachate quality data can be achieved at the end of the collection data period. Both data quality can be compared to the design capacity of LTP. The leachate parameter for raw leachate and after treated by electrolysis process i.e., temperature, pH, total dissolved solid (TDS), suspended solid (SS), initial dissolved oxygen (DO), chemical oxygen demand (COD) and biochemical oxygen demand (BOD) also compared with Standard Methods for the Examination of Water and Wastewater.

5.0 Leachate Characteristics

Leachate characteristics can be divided into two groups for rainy and sunny days to know the differences of leachate that would be generated during operation. This consists of the pH, temperature, COD, DO initial, BOD, TSS, and TDS. The changes in leachate concentration can be used as biodegradation indicators (Selin Top, 2017). Table 1 shows the data observation can give effect to leachate concentration during the period time from November to March. All the results are compared to the design parameter of raw leachate characteristics in Table 2. The experiment results obtained for leachate rainy and sunny days are summarized in Figure 2. The raw leachate was remained stable in alkaline (pH above 7.0) during the difference situation. The additional water percolating into raw leachate, the temperature become decreasing during the observation in site during the rainy. Almost all the parameter effect of seasonal variation.

Table 1: Data Waste and Rainfall Observation in JSL

Date	Volume of Waste (ton)	Depth of Rainfall (mm)	Date	Volume of Waste (ton)	Depth of Rainfall (mm)
Day 1	2605.96	-	Day 11	2471.48	19
Day 2	3211.10	-	Day 12	3205.62	-
Day 3	3105.86	2	Day 13	3270.68	-
Day 4	3117.36	5	Day 14	2679.82	7
Day 5	2737.08	14	Day 15	2538.14	28
Day 6	3183.40	12	Day 16	3089.88	-
Day 7	2390.20	-	Day 17	2776.22	-
Day 8	2638.00	1	Day 18	2402.84	-
Day 9	2444.34	-	Day 19	1266.94	5
Day 10	2535.74	-	Day 20	2446.44	2

Figure 2: Result Experiment Data by Characteristic of Raw Leachate

Samples		Temp. (^{0}C)	pH	COD (mg/l)	DO Initial (mg/l)	BOD (mg/l)	TSS (mg/l)	TDS (mg/l)
Sunny Day	**Average**	28.73	7.35	1,168.96	8.41	657.55	44.38	938.17
	Min	28.20	6.69	925.89	7.85	490.72	38.66	808.00
	Max	29.10	7.88	1,116.53	9.30	625.25	59.00	1,025.89
	SD	0.48	0.39	217.92	0.48	132.43	6.82	233.16
Rainy Day	**Average**	27.80	7.35	598.54	8.32	318.15	37.08	614.20
	Min	27.30	6.75	509.73	7.55	283.25	32.26	450.80
	Max	28.20	7.72	825.76	9.30	391.78	40.07	855.00
	SD	0.30	0.36	103.80	0.59	37.18	3.09	159.94

All samples during rainfall observation for all parameters decreased, this is because the sample experienced mixing with rainwater. The most significant dilution up to factor 1 over 40 but the dilution of the sample is not in one time. The rapid decreasing concentration of organic pollutant was presented in short time during rainfall day due to leaching out of pollutant. The concentration was increased due to the acceleration of biodegradation by moisture infiltrated when the waste was compacted in landfill. The concentration of organic contents in leachate was fluctuated and the trend of strength was declined with time.

Table 2: Comparison Characteristics of Design Parameter LTP of Raw Leachate (DEIA, 2007)

Characteristics	Mean		Design Capacity LTP
	Sunny Day	Rainy Day	
Temperature (°C)	28.73	27.80	27.17
pH	7.35	7.35	7.96
COD (mg/l)	1168.96	598.54	1311.50
DO (mg/l)	8.41	8.32	7.84
BOD (mg/l)	657.55	318.15	608.32
TSS (mg/l)	44.38	37.08	38.6
TDS (mg/l)	938.17	614.20	826.00

Leachate has a high BOD, which is related to the high COD showing a high organic load. The leachate is nearly the same as the design parameter raw leachate in the rainy and sunny season samples. BOD, DO initial, COD, TSS, and TDS are higher than the Effluents of Standard B. Results from the chemical analysis of leachate quality were analyzed and evaluated by comparing them with [Leachate] - Effluent Quality (Sewage and Industrial Effluents) Regulations, 1979 in Environmental Quality Act, 1974; [Surface water] -Interim National Water Quality Standards for Malaysia (INWQS), Department of Environment (DOE) (1995a) (Table 4). This study shows that rainfall affects changes in leachate quality. During rainy days the leachate becomes diluted and it also reduces the contaminant levels.

Leachate discharged from the dumping site should be lifted and treated before it is released. Untreated leachate is a violation of the Water (Prevention and Control of Pollution) Act, 1974 though raw leachate on rainy and sunny

days. This indicates that the water should not be used for any domestic purposes.

Table 4: Comparison Data Sample with Standard Effluent Quality

Parameter	Mean		Standard
	Sunny Day	Rainy Day	B*
Temperature (^{0}C)	28.73	27.80	40
pH	7.35	7.35	6 - 9
COD (mg/l)	1168.96	598.54	400
DO $_{\text{Initial}}$ (mg/l)	8.41	8.32	7 - 9
BOD (mg/l)	657.55	318.15	20
TSS (mg/l)	44.38	37.08	0
TDS (mg/l)	938.17	614.20	50

* Sewage and Industrial Effluents, 1979, DOE Malaysia

6.0 CONCLUSION

Raw leachate is characterized by a high chemical and biological oxygen demand, as well as the presence of unwanted organic and inorganic pollutants. We show to the quality of raw leachate may differ depending on the climate and hydrological conditions but raw leachate quality in the sunny season is much worse than in the dry season. The characteristics of the raw leachate were nearly the same in both seasons. The total waste and climate affect the characteristic of raw leachate. Treatment LTP technology techniques consist of physical, chemical, and biological methods recommended is necessary treatment methods to comply and make sure with the standard effluent quality before discharge to the river is achieved.

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