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A Study on Leachate Treatment of Amin Bazar Solid Waste Landfill Site

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Abstract

Water gets often affected by different pollutants by the means of different waste disposal. In countries like Bangladesh, open landfills are often claimed as the best effective options for disposal of various wastes. Aminbazar landfill has been serving as a major landfill site for disposal of wastes generated in North Dhaka City Corporation. Leachate generated in these landfills, can harm aquatic life and degrade the ecology if emitted untreated. That is why an efficient treatment plant is required. This paper serves the water treatment scenario of Aminbazar leachate treatment plant. The treatment plant includes hydro smart treatment, chemical treatment, anaerobic and aerobic treatment with activated sludge process, aeration tanks, dewatering screw press and other various treatment plant schemes. The paper further discusses about the removal efficiencies the various processes provide in the treatment processes. Average reduction efficiency of BOD, COD and TSS were found 99.34%, 99.44% and 93.44% by comparing the raw leachate and the final effluent. Though more methods like reverse osmosis, ultraviolet treatment, ultrafiltration, membrane bio reactor can work to improve the quality of water. For which it is important to know the current treatment practices in the treatment plants which is elaborated in the paper.

Keywords: *Treatment plants; Leachate; Bio-chemical Oxygen Demand (BOD); Chemical Oxygen Demand (COD); Water treatment.*

1 Introduction

Bangladesh's annual waste creation is expanding exponentially due to fast population expansion, urbanization, and industrial development (Alam and Qiao 2020). Inadequate landfill management and the formation of toxic leachate have a severe impact on surrounding freshwater and groundwater (Toufexi et al., 2013;
Kamal et al., 2016; Mishra et al., 2019). Leachate can be defined as, the liquid that results when water comes in contact with a solid and extracts material, either dissolved or suspended, from the solid (Jahan and Galib, 2016).
Treatments are essential to protect the environment from toxic leachate. This study discusses several treatment methods used for treating leachate in the Aminbazar landfill area and their reduction efficiencies.
The objectives of the study are to assess the water quality parameters of leachate before and after treatment and compare the water quality parameters of final effluent with different standards.

2 Methodology

Various leachate treatment processes are adopted in the Aminbazar landfill area. They are Grit Chamber, Equalization Tank, Coagulation Tank, Flocculation, Primary Clarifier, Anaerobic tank, Aeration Tank, Secondary Clarifier, Sludge pit & Sludge bed, Post aeration Tank, Multimedia Filter. The flow diagram of the treatment is shown in Figure 1. After the treatment processes, water quality parameters such as COD, BOD_5, TSS, pH, TN, NH_3-N, PO_4, Cl and TC were measured in the laboratory.

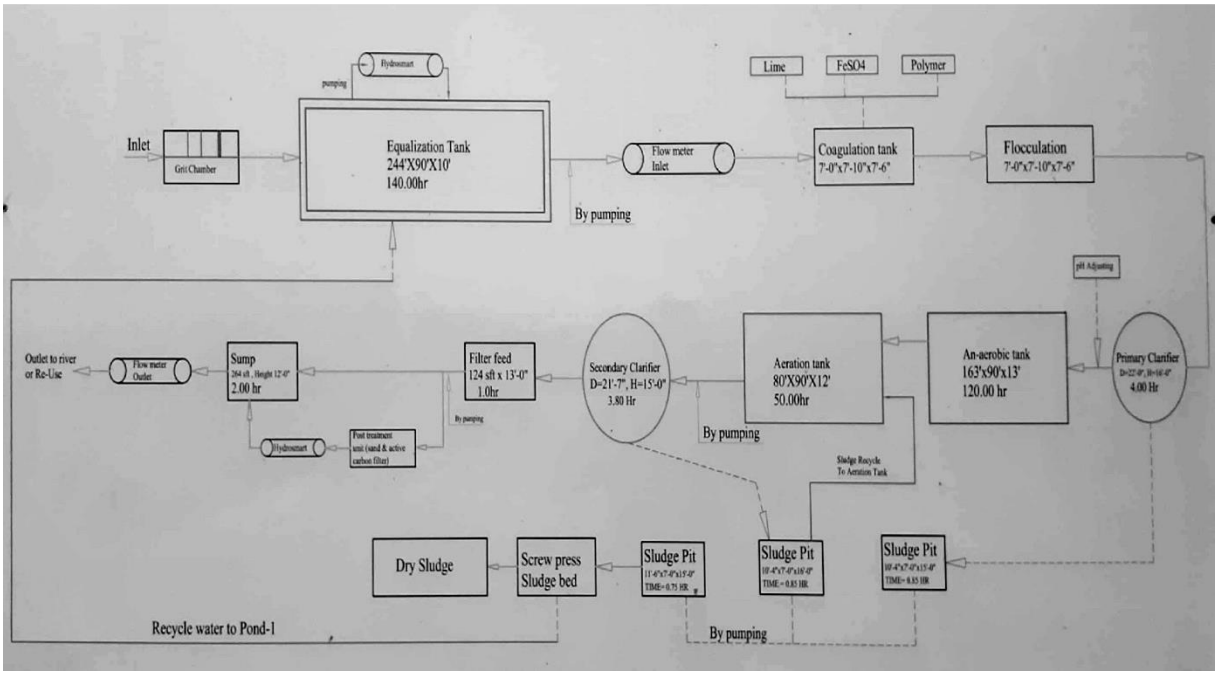

Figure 1. Flow diagram of treatment process

3 Data Analysis

In this study, the water quality parameters were mainly measured after treating in anaerobic and aerobic pond. After the whole process, parameters were measured at first, second and third month which are denoted as T-1, T-2 and T-3 respectively.

From Table 1, it can be seen that the water quality parameters decreased gradually. The raw leachate had a value of 5950 mg/L COD and in the third month (T-3) the value decreased to 33 mg/L.

Table 1. Water quality parameters in different Sources

Water Quality Parameters	Unit	Concentration Present in Sources					
		Raw Leachate	Anaerobic pond water	Aerobic pond water	Treated Leachate Water (T-1)	Treated Leachate Water (T-2)	Treated Leachate Water (T-3)
Chemical Oxygen Demand(COD)	mg/L	5950	2720	2200	183	88	33
Biochemical Oxygen Demand(BOD_5)	mg/L	2300	500	160	116	56	15
Total Suspended Solids(TSS)	mg/L	183	142	39	17	29	12
pH		8.12	8.48	8.41	7.73	7.07	7.05
Total Nitrogen (TN)	mg/L	2720	1540	1070	100	27.3	65
Ammonia-Nitrogen (NH_3-N)	mg/L	2675	1475	935	75	26.4	1.59
Orthophosphate(PO_4) or Reactive Phosphate	mg/L	80.5	35.5	15.5	2.3	0.81	0.22
Chloride(Cl)	mg/L	2000	2000	1750	144	105	27.21
Total Coliform(TC)	CFU/ 100 ml	TNTC	TNTC	TNTC	TNTC	200	-

In Table 2 the water quality parameters were compared with standard value (ECR'97). It can be observed that all the parameters met the standard range in different situations and can be discharged in inland water or into public sewer or irrigated land.

Table 2. Comparison with standard value

Water Quality Parameters	Unit	Concentration Present in Sources			Standard value (ECR'97)		
		Treated Leachate Water (T-1)	Treated Leachate Water (T-2)	Treated Leachate Water (T-3)	Discharge in Inland Water	Discharge into Public Sewer	Irrigated land
Chemical Oxygen Demand(COD)	mg/L	183	88	33	200	400	400
Biochemical Oxygen Demand(BOD_5)	mg/L	116	56	15	50	250	100
Total Suspended Solids(TSS)	mg/L	17	29	12	150	500	200
pH		7.73	7.07	7.05	6-9	6-9	6-9
Total Nitrogen (TN)	mg/L	100	27.3	65	-	-	-
Ammonia-Nitrogen (NH_3-N)	mg/L	75	26.4	1.59	50	75	75
Orthophosphate(PO_4) or Reactive Phosphate	mg/L	2.3	0.81	0.22	-	-	-
Chloride(Cl)	mg/L	144	105	27.21	600	600	600

The following Figure 2, 3, 4, 5, 6, 7 and 8 show the reduction efficiencies of different water quality parameters.

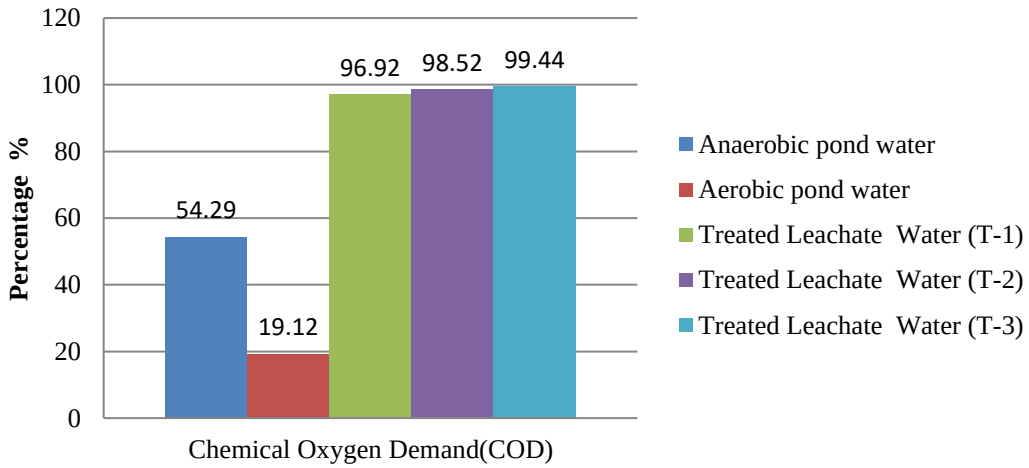

Figure 2. Reduction efficiencies of COD

According to (Alexiou and Mara, 2003), anaerobic pond can attain 60-85% removal efficiency of BOD_5. From Figure 3, it can be seen that the reduction efficiency of anaerobic pond is 78.26%. Similarly, the reduction rate at aerobic pond, first month (T-1), second month (T-2) and third month (T-3) are 68%, 94.96%, 97.57% and 99.34% respectively. It can also be seen that the reduction efficiency at anaerobic pond is higher than at the aerobic pond for BOD_5. On the other hand, from Figure 4 it can be identified that the reduction efficiency at anaerobic pond (22.4%) is lower than at the aerobic pond (72.54%). After being treated in anaerobic and aerobic ponds the reduction efficiencies of most of the water quality parameters increased gradually in first (T-1), second (T-2) and third (T-3) month.

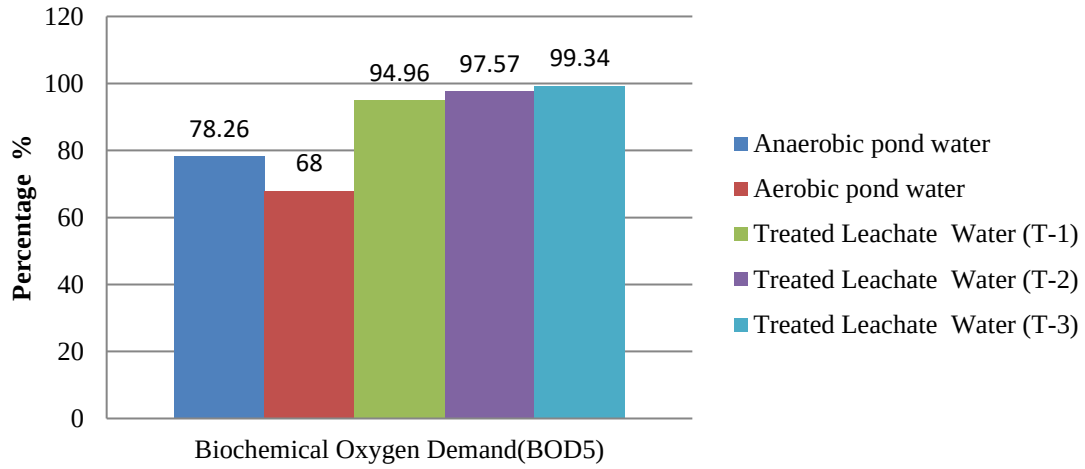

Figure 3. Reduction efficiencies of BOD_5

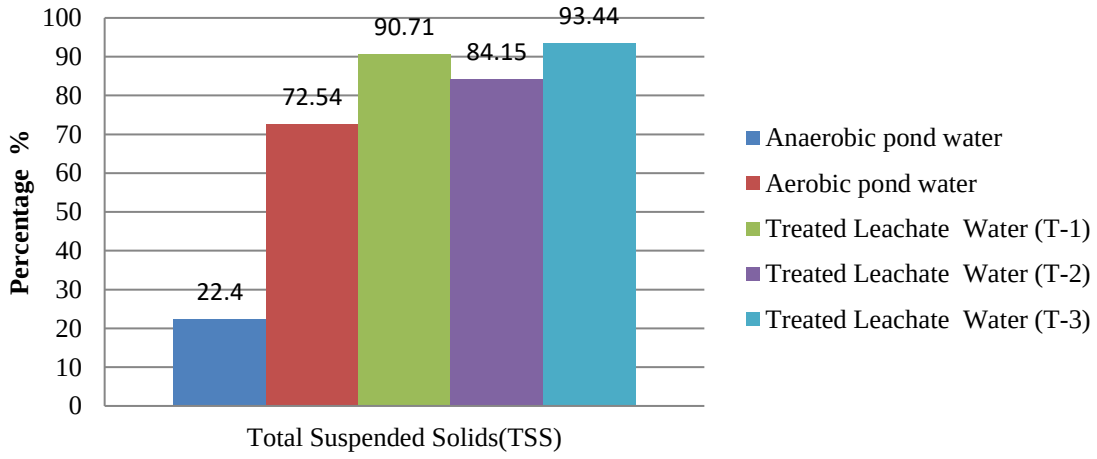

Figure 4. Reduction efficiencies of TSS

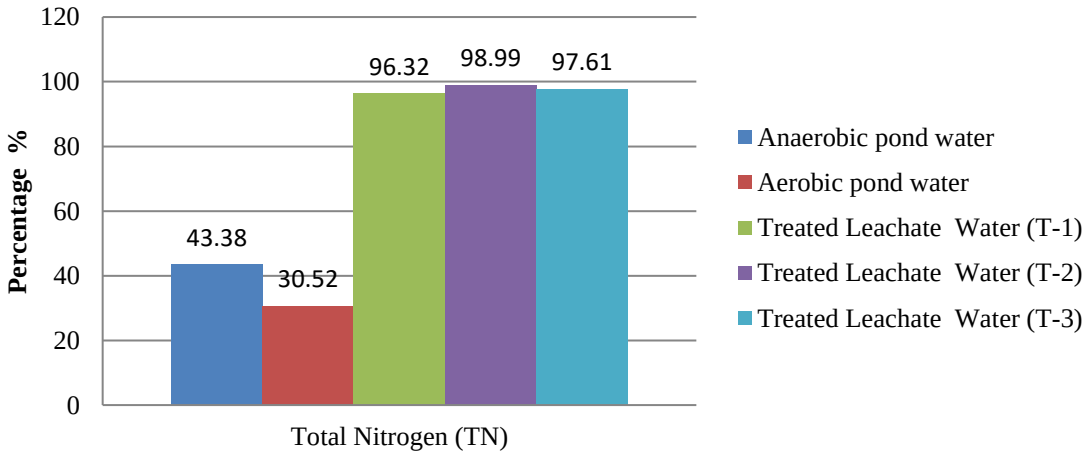

Figure 5. Reduction efficiencies of TN

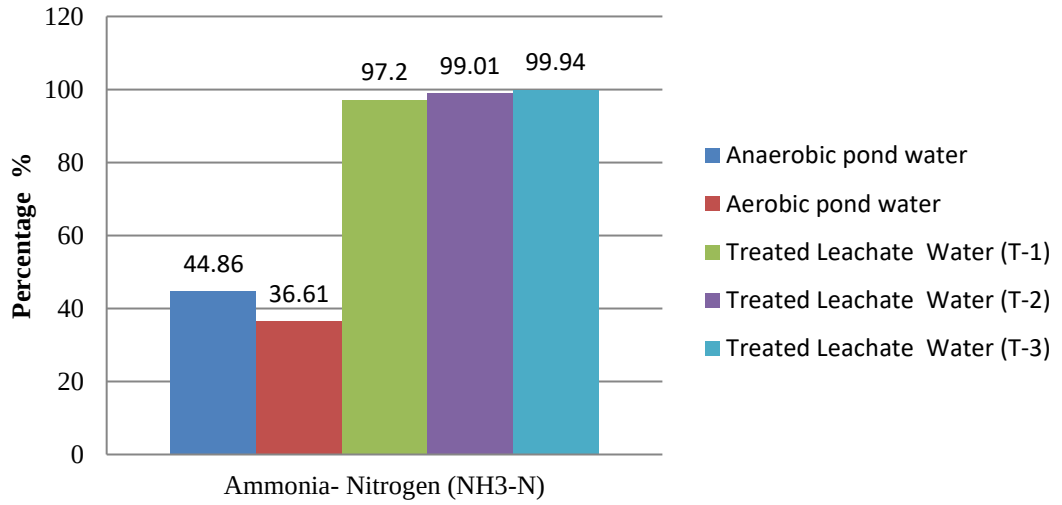

Figure 6. Reduction efficiencies of NH_3-N

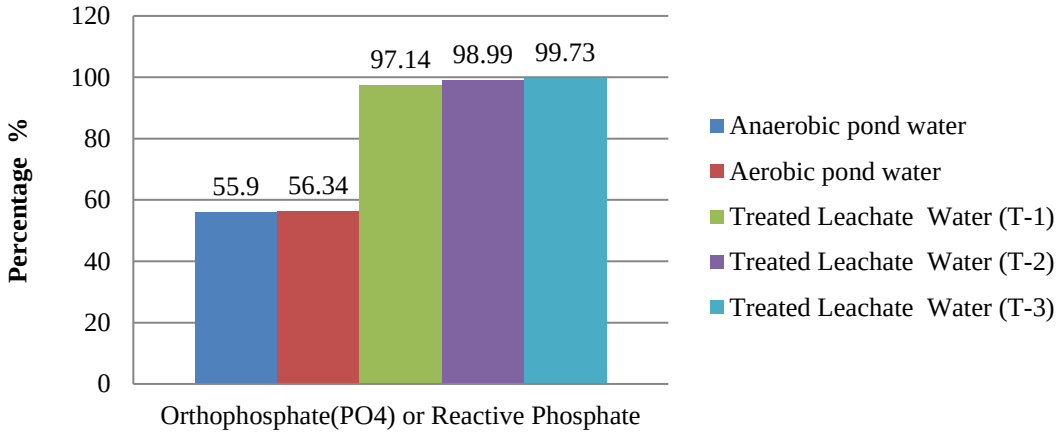

Figure 7. Reduction efficiencies of PO_4

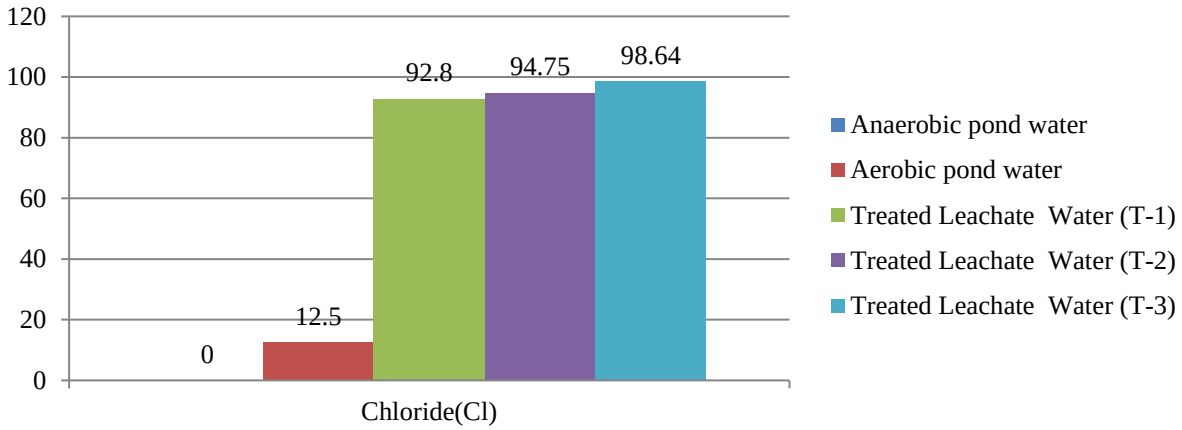

Figure 8. Reduction efficiencies of Cl

4 Conclusion and Recommendation

Leachate from landfills has the potential to be a hazardous waste. In this study the reduction efficiency values of water quality parameters of third month (T-3) are found to be the highest. So, it can be said that the values reduced greatly in terms of time. There are more methods such as reverse osmosis, ultraviolet treatment, ultrafiltration, membrane bio reactor which can be used to treat leachate.

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