Treatment of Landfill Leachate Mixed with Reverse Osmosis Reject Water using PAC (Poly Aluminum Chloride) as a Coagulant

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Abstract - *All waste water contains the high characteristics of Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Turbidity, total suspended solids, total dissolved solids and different other waste particles. Coagulation processes are used to separate these kinds of parameters from the waste water. The particles vary considerably in source, composition charge, particle size, shape, and density. The jar test treatability studies have been conducted to know the optimum dosage of poly aluminum chloride on the treatment of leachate mixed with reverse osmosis reject water. The optimum dosage of coagulant gives the removal efficiency of 85%, 71%, 75%, 77% and 73% of COD, BOD, Turbidity, TSS and TDS respectively.*

Key Words: Coagulation, PAC, Reverse osmosis reject water, leachate.

1. INTRODUCTION

Generation of solid waste is inevitable in the daily activities of humans and animals. A landfill is a site for the disposal of waste materials by burial and is the oldest form of solid waste treatment. Historically, landfills have been the most common method of organized waste disposal and remains so in many places around the world. Generally municipal solid waste is disposed of in low laying areas without taking any precautionary measures. Therefore, municipal solid waste is one of the major environmental problems of Indian issues. Solid waste management involves activities like generation, storage, collection, transfer and transport, processing and disposal of solid waste. But, in most cities, the Municipal solid waste management (MSWM) system consists of waste generation, collection, transportation and disposal. Management of MSW requires proper maintenance, basic facility and upgrading of all the activities (Ayub et al., 2011). Conventionally, landfill is designed to contain or store the waste so that exposure to human and environment can be reduced. In most of the countries municipal solid waste is dumped in a non-regulated landfill and the generated methane is emitted to the environment without any precautionary measures. When methane is emitted to the environment, it has a global warming potentially which pollutes the environment. Sanitary landfills can provide better solutions then open dumping of waste for reducing many of the problems, still there is a potential for improvement. Some of the modern regulated landfills attempt to capture and utilize landfill biogas, a renewable energy source, to generate electricity or heat (Ayub and Khan, 2011). At present, Reverse osmosis (RO) reject water technology has been applied in the wastewater treatment for sea water desalination, urban wastewater treatment, chemical industry, electric power, metallurgy and other industries, but the actual producing water rate in the RO process is only about 50%, so it still faces serious discharge problems of rejected water (Zhao et al., 2005). It is very meaningful to develop high-effective rejected water treatment process to compensate the deficiencies of RO and realize water saving and wastewater reducing (Reddy et al., 2007 and Wang et al., 2003).

2. MATERIAL AND METHODOLOGY

2.1 Sample Collection

Samples were collected from the open dump site landfill located at Multi Sector General Permit (MSGP) Bengaluru, Karnataka and the leachate are mixed with reverse osmosis (RO) reject water which were collected from the Penta pure (RO) system Hebbal, Bengaluru, Karnataka.

2.2 Poly Aluminum chloride

241.3g of PAC was weighed by using weighing balance and it was dissolved in 1000 ml distilled water resulting in 1 normal solution.

2.3 Methodology

The jar test procedures were adopted for different dilution of leachate mixed with RO reject water, which was taken in a beaker (1000mL). After adding appropriate volume of the poly aluminum chloride solution, the water was mixed at 100 rpm for 2 min and 40 rpm for 30 minutes and settled for 30 minutes. Then the top layer of water in each beaker was collected with a Pasteur pipette and measured in terms of COD, BOD, Turbidity, TSS and TDS. The jar testing apparatus containers were filled with sample waste water. One container was used as a control while the other 5 containers were adjusted depending on what conditions are being tested. Different dosage poly aluminum chloride was prepared for treatment of different dilution of waste water.

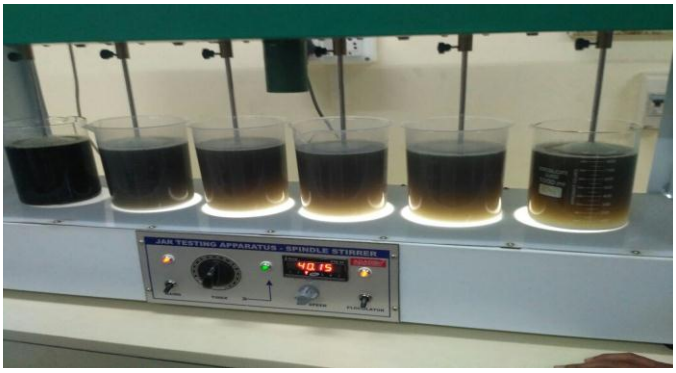

Figure 1: Coagulation Experiment in Standard Jar test Apparatus.

3. RESULTS AND DISCUSSION

The characteristic properties of waste water sample were shown in Table – 1. The waste water is alkaline having high COD, BOD, Turbidity, TSS and TDS values which needs to be treated before being discharged. It was reported that the neutralization of the electrical charges of particles into the water which causes the particles to floc together. The waste water sample has been treated with different concentrations of poly aluminum chloride.

Table 1: Initial Characteristics of Leachate.

PARAMETERS	INITIAL CONCENTRATION	CPCB STANDARDS 2016
pH	6.85	7.4
Conductivity(mS/cm^2)	30 – 80	-
Chemical Oxygen Demand(mg/L)	16860.0	50.0
Biological Oxygen Demand (mg/L)	9800.0	10.0
Turbidity (NTU)	619.0	5.0
Total Suspended Solids (mg/L)	1970.0	100.0
Total Dissolved Solids (mg/L)	38980.0	-

3.2 Effect of Dosage of Coagulants (PAC) on the Removal of COD, BOD, Turbidity, TSS and TDS (0.5 Liters of Leachate and 4.5 Liters of Reverse Osmosis Reject Water)

Figure 3.1 shows the variation in the removal efficiency of COD, BOD, Turbidity, TSS and TDS using PAC (2 – 12 mg/L) as a coagulant for the dilution of 0.5 liters of leachate in 4.5 liters of RO reject water was studied. In the experiment by the use of dosage of PAC 8 mg/L, the optimum removal efficiency of COD, BOD, Turbidity, TSS and TDS is about 88%, 78%, 72%, 75% and 70%. Further when the dosage was increased to 10 mg/L and 12 mg/L, there was no removal of COD, BOD, Turbidity, TSS and TDS this may be due to with the use of 8 mg/L is sufficient dosage for the treatment of 1L of wastewater.

3.2 Effect of Dosage of Coagulants (PAC) on the Removal of COD, BOD, Turbidity, TSS and TDS (1 Liters of Leachate And 4 Liters of Reverse Osmosis Reject Water)

Figure 3.2 shows the variation in the removal efficiency of COD, BOD, Turbidity, TSS and TDS using PAC (3 – 18 mg/L) as a coagulant for dilution of 1 liters of leachate in 4 liters of RO reject water was studied. In the experiment by the use of dosage of PAC 12 mg/L, the optimum removal efficiency of COD, BOD, Turbidity, TSS and TDS is about 88%, 78%, 72%, 75% and 70%. Further when the dosage was increased to 15 mg/L and 18 mg/L, there was no removal of COD, BOD, Turbidity, TSS and TDS this may be due to with the use of 12 mg/L is sufficient dosage for the treatment of 1L of wastewater.

3.3 Effect of Dosage of Coagulants (PAC) on the Removal of COD, BOD, Turbidity, TSS and TDS (2 Liters of Leachate and 3 Liters of Reverse Osmosis Reject Water)

Figure 3.3 shows the variation in the removal efficiency of COD, BOD, Turbidity, TSS and TDS using PAC (6 – 36 mg/L) as a coagulant at dilution of 2 liters of leachate in 3 liters of RO reject water was studied. In the experiment by the use of dosage of PAC 24 mg/L, the optimum removal efficiency of COD, BOD, Turbidity, TSS and TDS is about 88%, 78%, 72%, 75% and 70%. Further when the dosage was increased to 30 mg/L and 36 mg/L, there was no removal of COD, BOD, Turbidity, TSS and TDS this may be due to with the use of 24 mg/L is sufficient dosage for the treatment of 1L of wastewater.

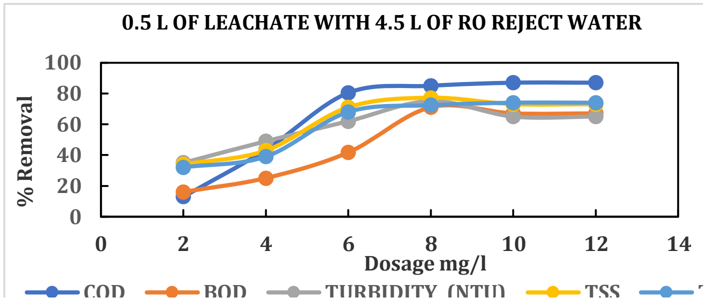

Figure 3.1: Effect of Dosage of Coagulants (PAC) on the Removal of COD, BOD, Turbidity, TSS and TDS (0.5 Liters of Leachate and 4.5 Liters of Reverse Osmosis Reject Water)

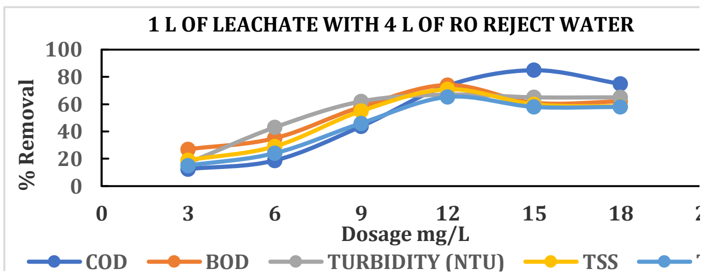

Figure 3.2: Effect of Dosage of Coagulants (PAC) on the Removal of COD, BOD, Turbidity, TSS and TDS (0.5 Liters of Leachate and 4.5 Liters of Reverse Osmosis Reject Water)

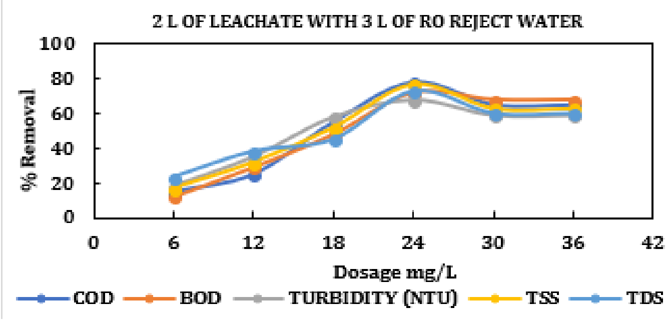

Figure 3.3: Effect of Dosage of Coagulants (PAC) on the Removal of COD, BOD, Turbidity, TSS and TDS (2 Liters of Leachate and 3 Liters of Reverse Osmosis Reject Water)

4. CONCLUSIONS

- PAC was effective in reducing the strength of the effluent considering the different dilution of municipal landfill leachate mixed with reverse osmosis reject water.
- Percentage removal of waste effluent by using PAC as a coagulant is about 60%-80%.
- PAC were found to be low in cost and convenient in usage.

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REFERENCES

[1] Prakash, N.B., Vimal, S., and Jayakaran., 2014, "Wastewater treatment by coagulation and flocculation" International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 3, pp. 479-484.

[2] Zainol, N.A., Aziz, H.A., Yusoff, M.S., and Umar, M., 2011, "The use of poly aluminum chloride for the treatment of landfill leachate via coagulation and flocculation processes" Research Journal of Chemical Sciences Vol. 1(3), pp. 34-39.

[3] Assou, M., Anouzla, A., Madinzi, A., Aboulhassan, M.A., Souabi, S., and Hafidi, M., et al., 2014, "Reducing pollution of stabilized landfill leachate by mixing of coagulants and flocculants: a comparative study" International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 4, pp. 20-25.

[4] Ghafari and Baskhir (2010), "The use of poly aluminum chloride for the treatment of partially stabilized leachate", A comparative study", Desalination, vol-257, pp 110-116.

[5] Ayub, S and Khan, A.H., 2011, "Landfill practice in India: A review", Vol – 3(4), pp 270 – 279.