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Treatment of Landfill Leachate using Coagulation

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Abstract—**Commercial/ conventional coagulant was used for the removal of COD and turbidity from landfill leachate containing COD 2451 mg/L. Coagulation studies were performed with lime and alum by varying parameters such as pH and coagulant dose. The experimental study shows that coagulation with calcium hydroxide and alum can remove up to 69% and 54% COD from the leachate. The optimum process variables of this coagulation study were found for calcium hydroxide and alum as pH 8 and 6; and coagulant dosage 25 g/L and 15 g/L, respectively.**

Keywords-Leachate; Coagulation; Calcium Hydroxide; Alum

I. INTRODUCTION

Landfilling is one of the least expensive methods for disposal of solid waste. It is reported that about 90% of municipal solid waste (MSW) is disposed in open dumps and landfills unscientifically, creating problems to public health and the environment [1]. If landfills are not properly managed, these can cause uncontrolled gaseous and liquid emissions. Liquid emission is termed as 'leachate' and it may contain several organic and inorganic compounds and heavy metals. The proper treatment and safe disposal of the leachate is one of the major environmental challenges worldwide especially in developing nations like India.

The landfill can be classified into three categories based on age: young, medium and old. Normally landfilling commenced within 5 years is termed as young age landfill. It consists of large amount of biodegradable matters and a higher COD value of 20000 mg/L. The 5 to 10 years old landfill site is known as medium age landfill and it consists of COD values in the range between 3000 to 15000 mg/L. After 10 years, the landfill contains very less amount of biodegradable matters and its COD value is lesser than 2000 mg/L. At this age, it is designated as old age landfill [**2**, **3**].

MSW leachate characteristics vary with time and from site to site because it depend on type of wastes disposed, rainfall, age of the landfill and design of the landfill etc [4]. The characteristics of the landfill leachates can usually be represented in terms of the basic parameters such as COD, BOD, ratio of BOD/COD, colour, pH, alkalinity, oxidation-reduction potential and heavy metal [5].

Coagulation-flocculation is mainly used for treating stabilized stage and old age leachate [2]. The main objective of coagulation and flocculation process is the removal of organic compounds from the leachate. During coagulation process, sludge is produced depending upon the characteristics of the leachate and the pollutant removal efficiency.

II. MATERIALS AND METHODS

A. Chemicals

All chemicals used in the present study were of analytical grade (A.R.), and were purchased from Merck chemicals, Mumbai, India. Leachate was collected from a landfill situated within the city of Mumbai, India.

B. Analytical Methods

pH of the leachate was measured using a digital pH meter (APX 175 E/C, Control Dynamics, India). COD was determined by the standard closed reflux method using a COD reactor (DRB200, Hach, USA). Turbidity was measured using a Turbidity meter (2100P, Hach, USA). TOC was measured using a TOC analyzer (TOC-VCSH, Shimadzu, Japan). The BOD_3 of leachate were determined by the modified Winkler's method [**6**]. Heavy Metal concentrations for the leachate were measured by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) (Ultima 2000, HORIBA Jobin Yvon, France).

C. Experimental

Coagulation study was done in Jar Apparatus (Trishul equipments, Thane).

D. pH study

The optimum pH of the process was determined from the data obtained from experiments carried out at varying initial pH of 2, 4, 6, 8, 10 and 12 and all subsequent experiments were carried out at this pH. HCl and NaOH were used for pH correction

E. Dosage study

Calcium hydroxide and Alum were used as coagulant in this study. Coagulant dosage was optimized by performing the experiments at varying coagulant dosage (10, 15, 20, 25, 30 and 35 g/L) at optimum pH and analyzed for COD [6].

F. Coagulation Study

As mentioned earlier, leachate was used for this coagulation studies. All the coagulation experiments were done in 250 mL glass beakers containing pre determined amount of coagulant with 100 mL of landfill leachate. The beakers were labeled and kept in jar apparatus stirred at 200 rpm for 3 min and at 60 rpm for 20 min, and is, then, allowed to settle for 1 hr.

Batch experiments were carried out to evaluate the effect of pH and coagulant dose on the coagulation of leachate. To evaluate the efficiency of Coagulation, COD and turbidity of leachate were measured before and after the treatment.

III. Results and Discussion

A. Characteristics of Landfill Leacahte

The characteristics of leacahte are shown in Table I. Initial pH is 7.6 and COD is 2451 mg/L.

TABLE I. CHARACTERISTICS OF LANDFILL LEACHATE

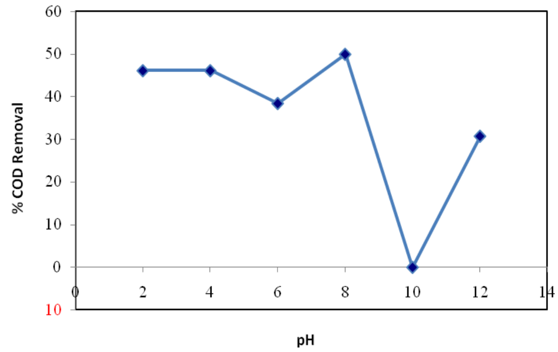
Parameter	Value
pH*	7.6
Colour*	Dark Brown
COD	2451
TOC	655
BOD_3	202
BOD/COD	0.09
TS	10320
TDS	9787
TSS	533
Na	1810.6
K	621.7
B	3.729
Ca	40.30
Mg	117.9
Fe	1.200
Si	16.60
Al	0.302
As	0.087
Ba	0.510
Bi	0.155
Co	0.111
Cr	0.166
Cu	0.272
Hg	0.016
Li	0.076
Mn	0.344
Ni	0.511
Se	0.094
Sr	1.850
V	0.120
Zn	0.170

* Except pH, Color and Conductivity (µS), all values are in mg/L.

B. Effect of pH on the Coagulation of leachate using Calcium Hydroxide and Alum

Results obtained from the coagulation of leachate using Calcium hydroxide at varying initial pH values are shown in Figure 1. Calcium hydroxide was kept 15 g/L in all the runs. It shows that the maximum COD removal at pH 8 and that resulted in a 50% reduction from the initial value. Hence all subsequent experiments were carried out at this pH. It may be noted that maximum turbidity removal (99.82%) occurred at pH 6 (Figure 1).

Figure 2 shows the affect of pH on the coagulation of leachate using alum. It shows that the maximum COD removal, 38% reduction from the initial value, at pH 6. Hence, all subsequent experiments were carried out at this pH. Here also, maximum turbidity removal (98%) occurred at pH 10 (Figure 2).



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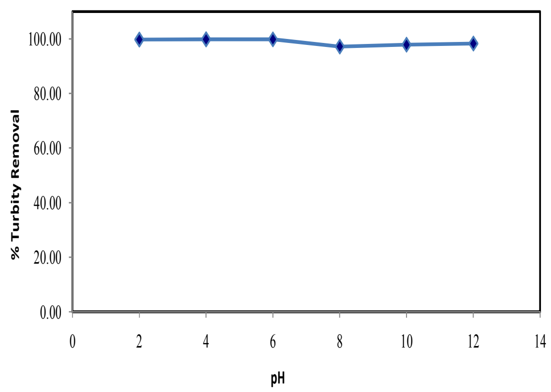

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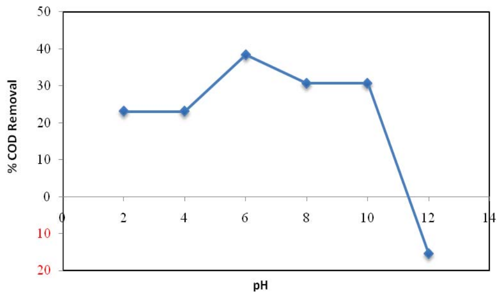
Figure 1. Effect of pH on the Coagulation of Leacahte using Calcium Hrdroxide. Experimental conditions: Calcium hydroxide used = 15 g/L; initial COD of Leachate = 2451 mg/L, Initial Turbitidy = 317 NTU



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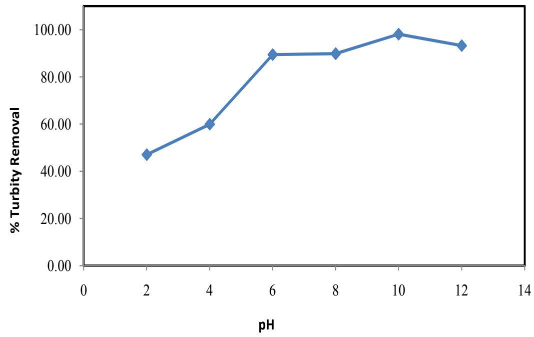

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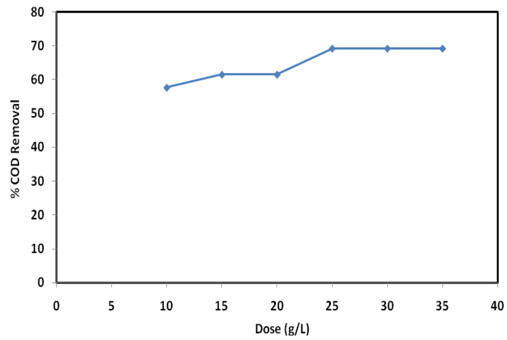
Figure 2. Effect of pH on the Coagulation of Leacahte using Alum.. Experimental conditions: Alum used = 15 g/L; initial COD of Leachate = 2451 mg/L, Initial Turbitidy = 317 NTU

C. *Effect of Coagulant Dose on theCoagulation of Leachate using Calcium Hydroxide and Alum*

To observe the effect of coagulant dose, the experimental runs were conducted at different doses (10, 15, 20, 25, 30 and 35 g/L) as shown in Figure 3 and 4. In case of Calcium hydroxide, COD removal was increased upto 69 % at 25 g/L coagulant dose, after this dose the COD removal was constant. The maximum turbidity removal was also achieved at 25 g/L of coagulant dose.

In case of alum, the maximum COD removal of 54% resulted at 15 g/L coagulant dose. The COD removal was constant after the addition of 15 g/L of alum. The maximum turbidity removal (94%) achieved at 10 g/L (Figure 4).



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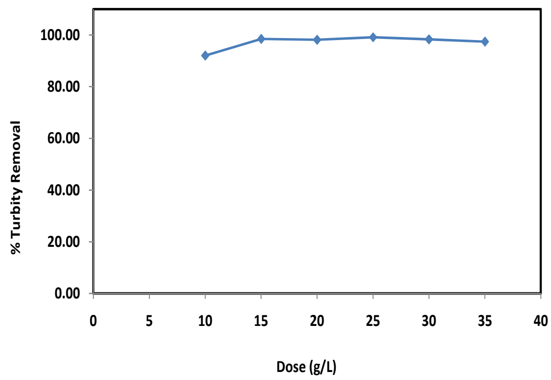

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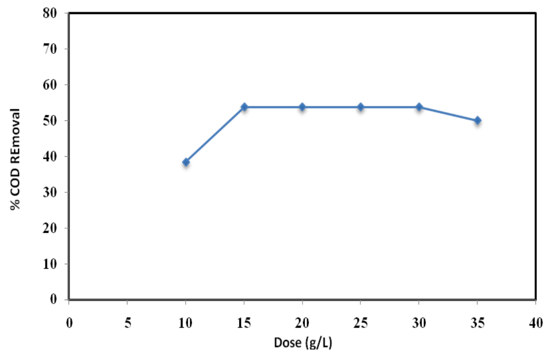
Figure 3. Effect of Calcium Hrdroxide Dose on Coagulation of Leachate Experimental conditions: Initial pH= 8, initial COD of Leachate = 2451 mg/L, Initial Turbitidy = 317 NTU



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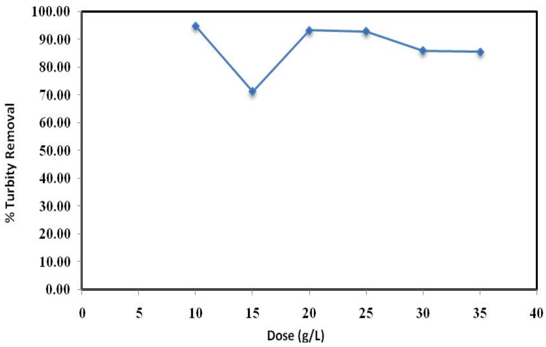

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Figure 4. Effect of Alum Dose on Leachate. Experimental conditions: Initial pH= 8, initial COD of Leachate = 2451 mg/L, Initial Turbitidy = 317 NTU

IV. CONCLUSION

The present study proved that the calcium hydroxide and Alum remove upto 69% and 54% of COD from the landfill leachate by coagulation. The calcium hydroxide and alum remove up to 99.9% and 94% turbidity from the leachate. Calcium hydroxide gave more removal of COD and turbidly.

The optimum process variables of the coagulation of landfill leachate using calcium hydroxide were found as pH 8 at coagulant dosage of 25 g/L.

REFERENCES

[1] Sharholy, M., Ahmad, K., Mahmood, G., and Trivedi, R., “Municipal solid waste management in Indian cities - A review,” Waste Management, vol. 28 (2), 2008, pp. 459–467.

[2] Stegmann, R., Heyar, K. U. and Cossu, R. “Leachate Treatment”, Proceedings Sardinia, Tenth International Waste Management and Landfill Symposium S. Margherita di Pula, Cagliari, Italy (2005).

[3] Lema, J. M., Mendez, R. and Blazquez, R. “Characteristics Of Landfill Leachates and Alternatives for Their Treatment: A Review”, Water Air Soil Pollution, 40, (1988), pp. 223-250.

[4] Renou, S., Givaudan, J. G., Poulain, S., Dirassouyan, F., and Moulin, P., “Landfill leachate treatment: Review and opportunity,” Journal of Hazardous Materials, vol. 150(3), pp. February 2008, pp. 468–493.

[5] Kjeldsen, P., Barlaz, M. A., Rooker, A. P., Baun, A., Ledin, A., and Christensen, T. H. “Present and long-term composition of msw landfill leachate: A review,” Critical Reviews in Environmental Science and Technology, *32*(4), (2002), pp. 297–336.

[6] American Public Health Association (APHA). Standard Methods for the Examination of Water and Wastewater, 21st ed., (2005) APHA, Washington, DC.