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STUDY OF DO AND AMMONIACAL NITROGEN IN LEACHATE USING WHEAT HUSK ASH AS ADSORBENT

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Abstract: *Leachate generation inside Solid Waste Landfills and Dumpsite is regarded as a major threat to the environment that has to be managed utilizing proper disposal systems and waste management techniques. In this study, the leachate characteristics such as pH, Turbidity, EC, TDS, TSS, DO and Ammoniacal Nitrogen were identified and the leachate was treated with wheat husk ash to reduce the concentration of DO and Ammoniacal Nitrogen. The conditions such as contact time, adsorbent dosage and pH were varied to identify the maximum reduction in concentration. it is found that Wheat husk ash can be utilized as a low cost adsorbent which is said to be a feasible technique in treating the leachate.*

INTRODUCTION

Leachate is formed as a result of rainfall, surface run-off and seepage of groundwater that percolates through the landfill[1-8]. There are three classes of landfill leachate in terms of landfill age: the young, middle-age, and mature landfill leachate [9-10]. The reduction in concentrations of OD and ammonium compounds present inside leachate is an essential requirement before discharging it into rivers, lakes or water bodies.The treatment of leachate can be categorized into two main types such as physical (adsorption)/ chemical (coagulation, flocculation) and biological (using microbes) methods[11-15]. Biological process is conventionally preferred to physico-chemical methods but application of biological treatment alone does not fulfill the satisfactory requirement of effluent quality confirming to standard of regulatory board due to presence of many dissolved toxic constituents in leachate. Adsorption process is a conventional and economical process for treatment of dissolved toxic and organic matters.

COLLECTION OF LEACHATE SAMPLES

The leachate sample was collected in a 10litre can which was washed with water and dried in sunlight. The leachate was collected beside the boundary wall of the dumpsite where the leachate was stagnant. The collected leachate was refrigerated at 4ºC to inhibit any change in characteristics.The collected sample is shown in Fig. 2(a)

PREPARATION OF ADSORBENT

Raw Wheat husk was obtained commercially from Chrome pet. It was then washed with distilled water to remove any impurities or dust present in it. It was then allowed to dry and crushed. The rice husk was then converted into Wheat-Husk Ash(W-HA) by heating it in a muffle furnace at 150ºC for 24 hours. The rice husk ash is shown in Fig. 2 (b) and its characteristics are shown in Table 1.

Table1: Wheat Husk Ash Characteristics

PARAMETERS	VALUES

pH	6.4
Moisture Content (%)	2.5
Density (g/cm^3)	1.13
Bulk Density (kg/m^3)	168

RESULTS AND DISCUSSION

Leachate Characterization

The Leachate Sample I (LeS I), Leachate Sample II (LeS II) and Leachate Sample III (LeS III) collected from the dumpsite was characterized by laboratory analysis are shown in Table 2. The leachate characteristics are as follows:

Table 2: Characteristics of Leachate

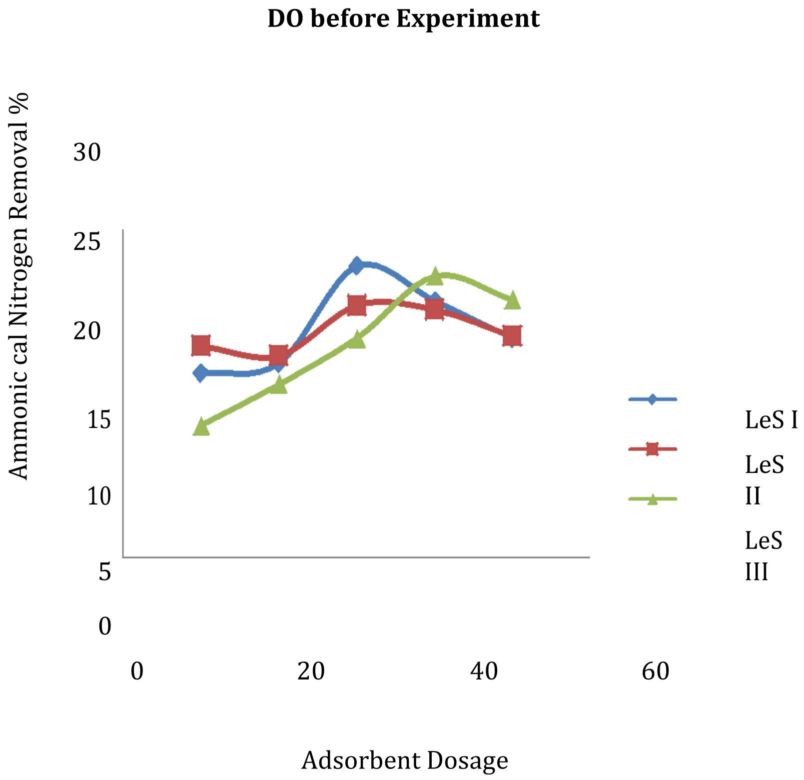
PARAMETERS	VALUES			UNIT	TESTING METHOD
	LeS I	LeS II	LeS III		
pH	7.2	6.8	5.9	-	pH meter
Odour	Foul smell	Foul smell	Foul smell	-	Physical sensation
Colour	black	Brown	black	-	Physical appearance
Turbidity	3.64	4.41	3.18	NTU	Turbidity meter
Electrical Conductivity	12.6	10.0	18.2	µS/ cm	EC meter
Total Suspended Solids	365	300	290	mg/ l	Gravimetric method
Total Dissolved Solids	1010	1580	1110	mg/ l	TDS meter
Dissolved Oxygen	5.40	5.00	5.17	mg/ l	DO probe
Ammoniacal nitrogen	740	683	715	mg/ l	Nesslerization method

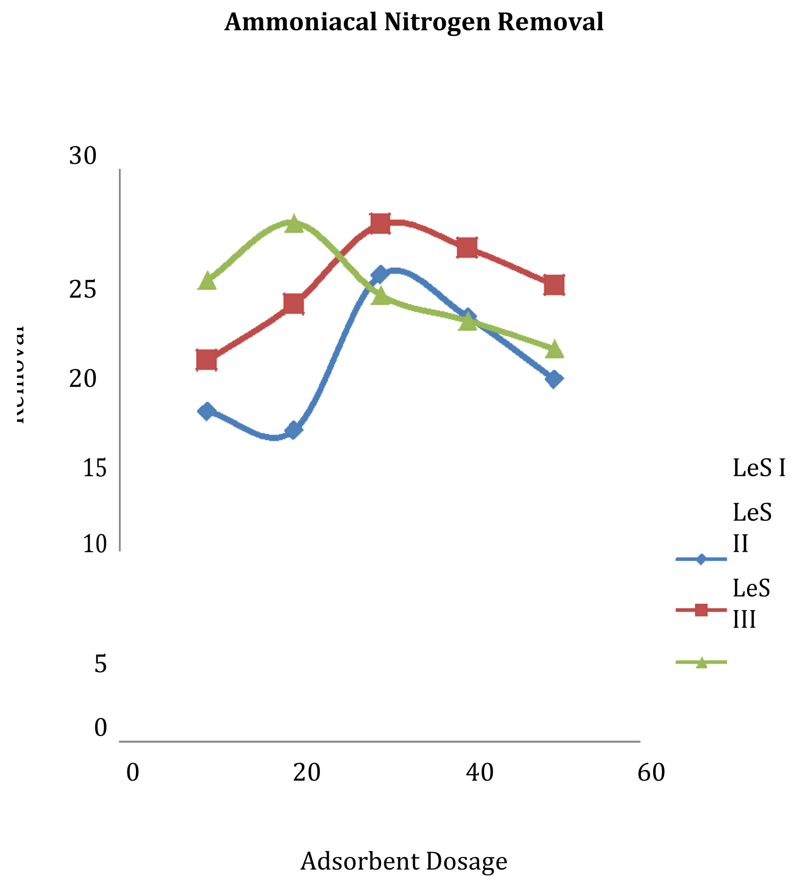
Effect of Adsorbent Dosage

100ml of Leachate Sample I (LeS I), Leachate Sample II (LeS II) and Leachate Sample III (LeS III) was taken respectively in five conical flasks each. The rice husk ash was added in dosages of 10, 20, 30, 40 and 50 g to each of the conical flasks containing the samples. The solution was then mixed well and strained with the help of a filter paper. The sample was then analyzed to find the dosage which has high removal efficiency. Table 3 represents the efficiency of DO.

Table 3: Effect of Adsorbent Dosage

Adsorbent Dosage (g)	Ammoniacal Nitrogen Removal (%)		
	LeS I	LeS II	LeS III
10	10	12	21.0
20	9.4	17.4	25.0
30	21.2	25.1	21.0
40	15.4	20.8	13.1
50	13.0	21.0	15.0





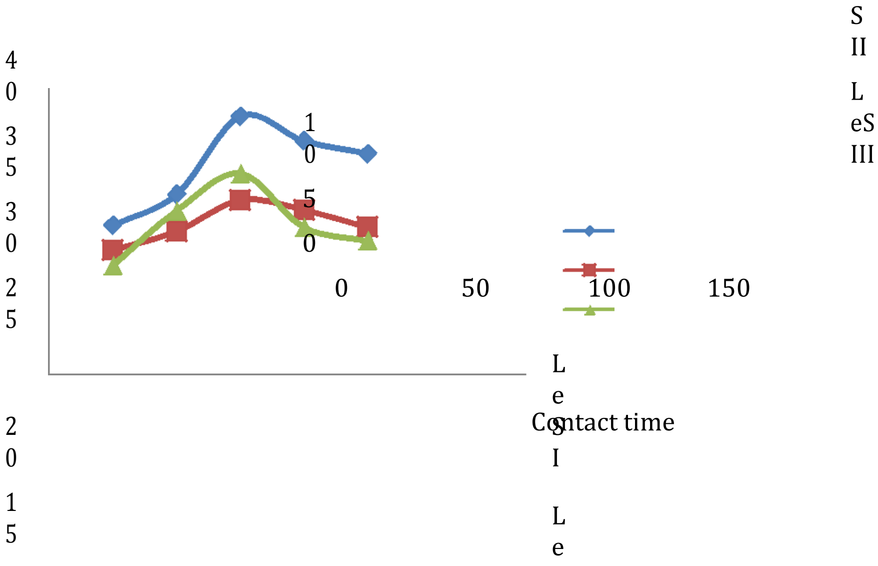
(b)

Fig 3: Adsorbent Dosage - (a) DO before experiment (b) Ammoniacal Nitrogen Removal

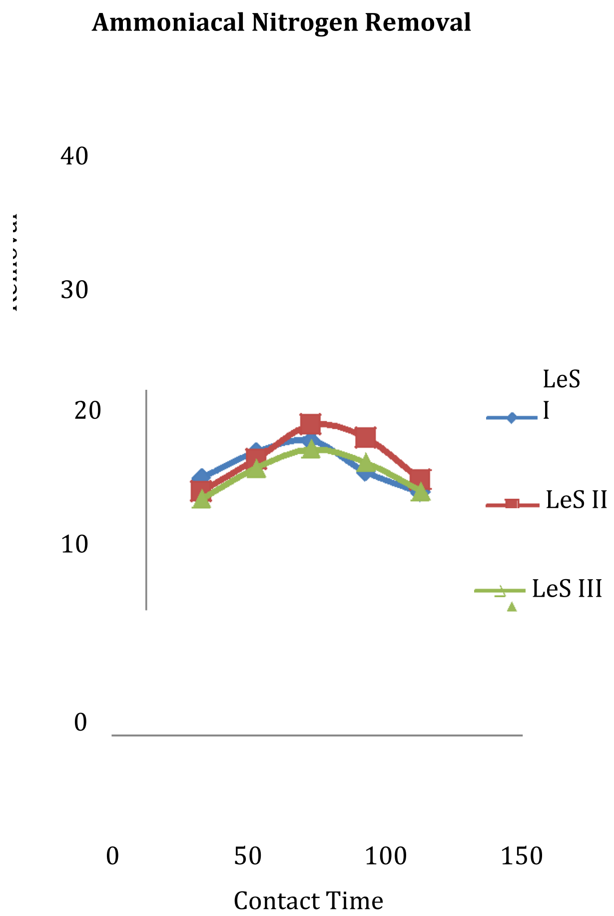
Effect of Contact Time

100ml of Leachate Sample I (LeS I), Leachate Sample II (LeS II) and Leachate Sample III (LeS III) was taken respectively in five conical flasks each. The rice husk ash was added in dosages of 30g to each of the conical flasks containing the samples. The solution was then mixed well for various contact periods of 20, 40, 60, 80 and 100 minutes respectively and strained with the help of a filter paper. The sample was then analyzed to find the dosage which has high removal efficiency. Figure.4 (a)and (b) shows the removal efficiencies of DO and Ammoniacal Nitrogen respectively by varying the contact time.

DO after experiment


S
II
L
eS
III
4
0
3
5
3
0
2
5
2
0
1
5
1
0
5
0
0
50
100
150
L
e
S
I
L
e
Contact time

(a)



(b)

Fig 4: Contact Time -(a) DO after experiment (b) Ammoniacal Nitrogen Removal

Effect of pH

100ml of Leachate Sample I (LeS I), Leachate Sample II (LeS II) and Leachate Sample III (LeS III) was taken respectively in five conical flasks each. The Wheat husk ash was added in dosages of 30g to each of the conical flasks containing the samples. The solution was then mixed well for a contact period of 60 minutes and strained with the help of a filter paper. The sample was then analyzed to find the dosage which has the highest removal efficiency. Table 5 shows the removal efficiency of DO Figure 5(a) and (b) shows the removal efficiencies of DO and Ammoniacal Nitrogen respectively by varying the pH.

Table 5: Effect of pH

pH	Ammoniacal Nitrogen Removal (%)		
	LeS I	LeS II	LeS III
5	31.2	32.1	19.2
6	42.1	43.4	29.1
7	21.2	34.5	35
8	19.6	20.7	25.6

Adsorption Isotherm

The adsorption mechanism can be determined by estimating the equilibrium data (adsorption data)acquired from the experiment. The current study dealt using Langumuir and Freundlich isotherms to determine the adsorption data.

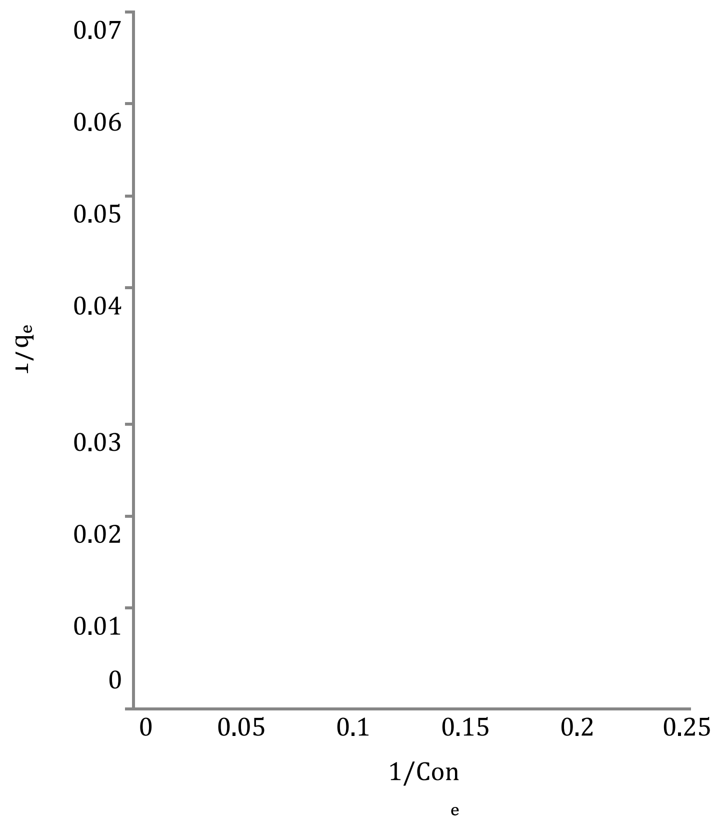
Langmuir Isotherm

The assumptions for Langmuir Isotherm model are:

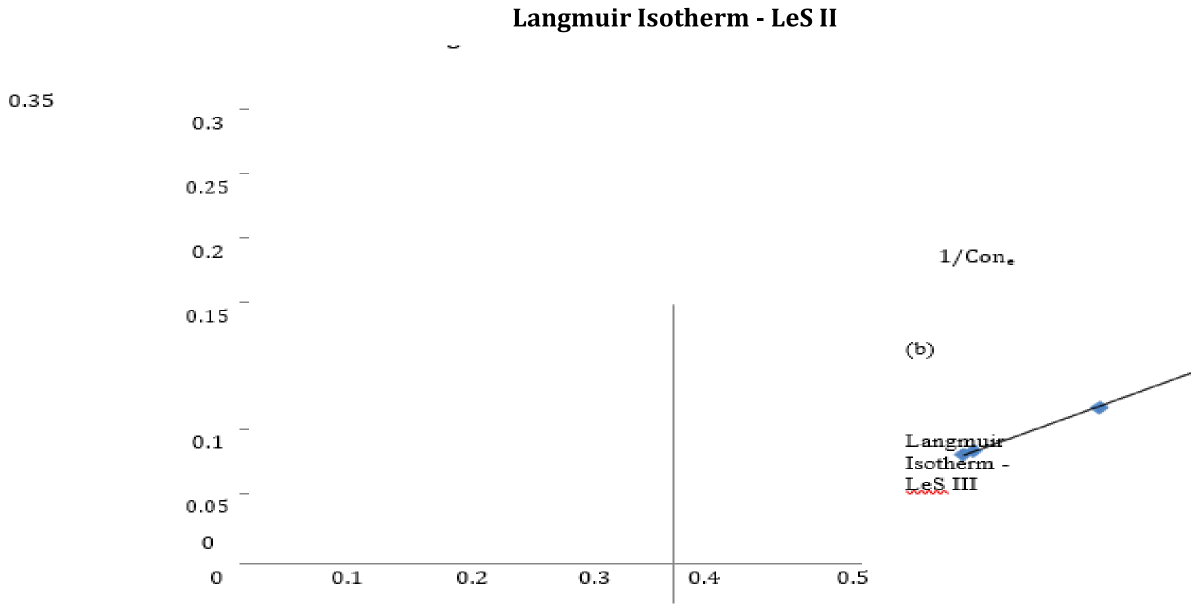
i. Monolayer formation happens on the surface of the adsorbent.
ii. Surface of adsorbent is homogenous, possess identical and energetically equivalent adsorption site.

The Langmuir adsorption isotherm study for the detrmination of DO for three samples is represented graphically in Figures 6 (a), (b) and (c) and similarly the Langmuir isotherm for Ammoniacal Nitrogen is given in Figures 7 (a), (b) and (c)respectively.

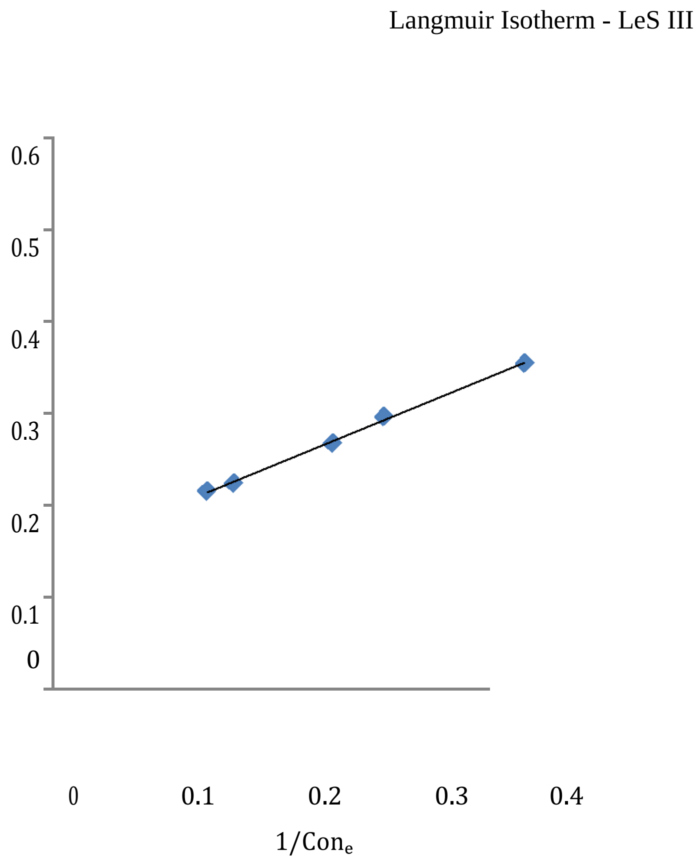
Langmuir Isotherm - LeS I



(a)


Langmuir Isotherm - LeS II
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0 0.1 0.2 0.3 0.4 0.5
1/Cone
(b)
Langmuir Isotherm - LeS III

(b)


Langmuir Isotherm - LeS III
0.6
0.5
0.4
0.3
0.2
0.1
0
0 0.1 0.2 0.3 0.4
1/Cone

(c)

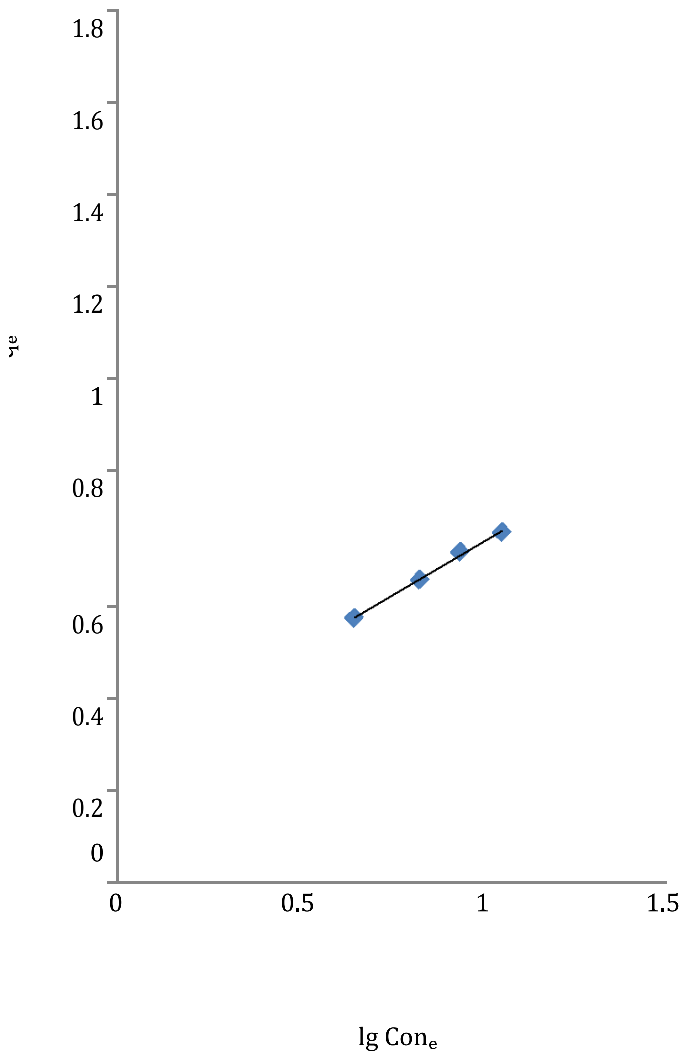
Freundlich Isotherm

i. The Freundlich model is applicable to heterogeneous systems

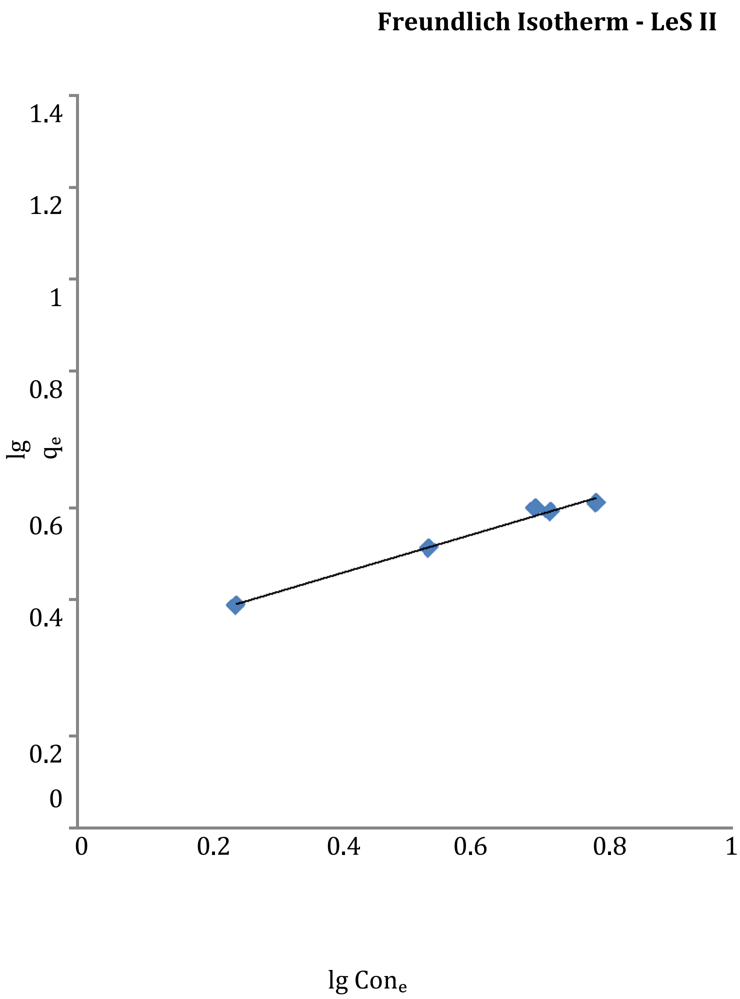
ii. Formation of a multilayer.

The Freundlich adsorption isotherm study for the determination of DO is represented graphically in Figures 8 (a), (b) and (c) , Similarly the Langmuir isotherm for Ammoniacal Nitrogen is given Figures 9 (a), (b) and (c) respectively.

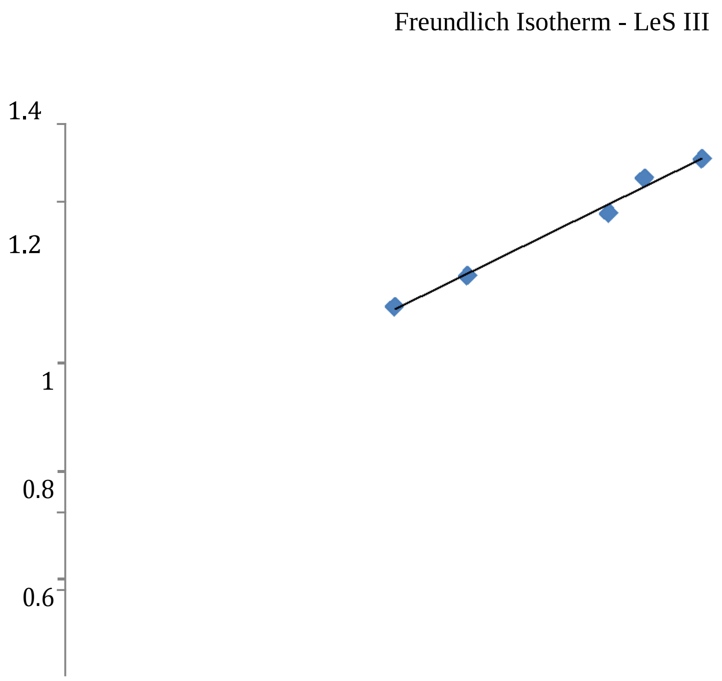
Freundlich Isotherm - LeS I

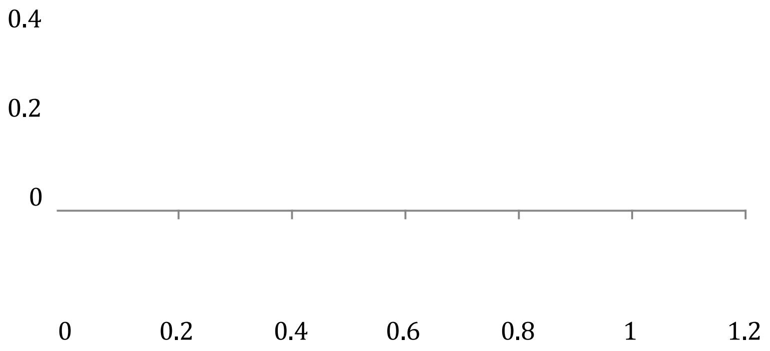


(a)


Freundlich Isotherm - LeS II
1.4
1.2
1
0.8
lg qe
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
lg Cone

(b)


Freundlich Isotherm - LeS III
1.4
1.2
1
0.8
0.6



(c)

Fig 8: Freundlich Isotherm for DO – (a) LeS I (b) LeS II (c) LeS III

CONCLUSION

The feasibility of utilizing Wheat-Husk Ash (W-HA) for the treatment of leachate for DO and Ammoniacal Nitrogen was studied and evaluated using adsorption process. The optimum conditions such as adsorbent dosage, contact time and pH were varied. The present study showed that R-HA, a natural adsorbent is helpful in the treat leachate by a maximum removal efficiency.

The adsorption process follows both Langmuir and Freundlich isotherms. It was found that maximum adsorption efficiency was obtained for adsorbent dosage of 30g, contact time of 60 minutes and pH 7 for DO and pH 6.5 for Ammoniacal Nitrogen.

CONFLICT OF INTEREST

The authors would like to declare that there are no conflicts of interest regarding the publication of this paper.

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