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Adsorption - Desorption Behaviour Of Nickel (II) On Natural Clays Alone and In a Blend.

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ABSTRACT

In understanding the adsorption tendency of nickel (II) on natural clays, the present study aimed at investigating the optimum conditions like pH, contact time, adsorbent dosage and initial concentration for adsorption of nickel (II) as these operating conditions greatly influence the adsorption process. Batch experimental study was performed to understand the adsorption-desorption tendency with the synthetic solution of nickel (II) on the commercially available clays namely bentonite and kaolinite alone and an admix of these clays at various proportions of 80% bentonite (B) + 20% kaolinite (K), 60% B + 40% K, 40% B + 60% K, 20% B + 80% K and 100%. The results revealed that the percentage adsorption of nickel (II) was significant at pH 8 on bentonite clay, where as for kaolinite clay it was pH 6. On both the clays under the optimum conditions the percent of adsorption of nickel (II) was found to have decreased with increase in initial concentration from 5 mg/L to 100 mg/L. The Freundlich and Langmuir isotherms were plotted which has given a best linear fit for the batch experimental data. Further investigation was carried out to identify the percentage desorption of nickel (II) using several extractants on the exhausted adsorbents stored and dried after the batch experimental studies.

Keywords: Adsorption-desorption, Ni (II), Natural Clays, Freundlich isotherm, Langmuir isotherm.

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INTRODUCTION

Through the speedy urbanization and industrialization activities though the financial system of any country gets strengthened, the waste turns out to be widely disseminated over the earth's surface and is excessively concentrated in localized areas, predominantly in regions of high population density zones leading to the undesirable changes and finally polluting the giant ecosystem. Although many heavy metals are essential biological elements at low concentration, they are all potentially toxic to organisms above certain threshold concentrations.

Nickel (Ni) a heavy metal whose natural content in the soil can vary from very small proportions (< 5 mg kg-1), which qualify it as a trace element, to excessively high concentrations (5000 mg kg-1), found in the soils formed on ultra basic igneous rocks (1, 2). Ecological constancy is maintained by natural soils, their superiority is negotiated by natural and anthropogenic sources leading to the accumulation of substantial heavy metal concentrations including nickel. The Phosphate fertilizers, Bio-solids and pesticides initiate the spring of nickel input to environment (3). Until now nickel functional role as a trace element was not yet documented on organisms and turn out to be trace metal of concern. The foremost path of nickel exposure to animals or man is during the dietary intake including the contaminated food chain, growing crops, fruits and vegetables on nickel contaminated soils. The long-term, over-exposure to nickel and nickel compounds by human escort health problems like allergic dermatitis, prevalence of Lung cancers, nasal mucosa, effects the cardiovascular and respiratory systems and many more. In nickel compounds, nickel sulfide and nickel oxide identified as most hazardous (4). The increased concentrations of nickel inputs to soil environment becomes more problematic with decrease in soil pH and is the major factor increasing and controlling nickel solubility, sorption and mobility (5). Nickel mobility in environment is low at neutral to alkaline and moreover in reducing conditions too, however in acidic organic rich soils nickel was quite mobile and may contaminate the water environment (6).

The chief objective of the present study is to understand the adsorption behaviour of nickel (II) on bentonite and kaolinite clays as they are active subsets of soils and has an ability to bind various metal ions. As the desorption process is the phenomena which plays a key role in the transport of the metal ions to the ground water, in the present study further investigation on desorption were also carried out using a variety of extractants. This information is useful for environmental chemist to focus on adsorption-desorption of metal ions by soil systems.

EXPERIMENTAL

The adsorption of Nickel (II) using commercially available mineral adsorbent namely bentonite and kaolinite clay was carried out individually in a batch study. The effect of various parameters like pH, contact time, adsorbent dosage and initial concentration of nickel (II) was investigated.

All the chemicals used were of analytical grade and millipore water was used for all experimental work. 100 mg/L of nickel (II) stock solution was prepared by dissolving 0.447 gm of nickel sulphate in millipore water and made up to the mark in 1000 ml volumetric flask. The required concentration of metal solution was prepared by dilution as per the requirement. As the pH play an important role in adsorption studies, the pH of the working solution was varied between 1 and 9 at optimum contact time of 60 minutes, 100 g/L adsorbent dosage at initial concentration of 50 mg/L of nickel (II). Then the supernatant solution was taken and the final nickel concentration was determined after the batch adsorption studies. The contact time was varied between 5 to 420 minutes at optimum conditions of pH 8 on bentonite and pH 6 on kaolinite clays and then the optimum dosage of the adsorbents was selected by varying dosage between 2 to 10 g at an initial concentration of 50 mg/L of nickel (II) using optimum contact time i.e. 60 minutes and 5 hours respectively for bentonite and kaolinite clays at the selected respective pH. Applying the optimum condition of equilibrium contact time, dosage and pH the initial concentration was varied between 5 mg/L to 100 mg/L. The amount of nickel (II) remaining in the solution was determined spectrophotometrically using standard methods (6, 7). A blend of the two clays was prepared by varying portions of percentage by weight between 20 to 80% and pure clay system, the investigation was carried at the optimum conditions from the batch adsorption studies. Further investigation was carried out to identify the percentage desorption of nickel (II) from the exhausted adsorbents of batch experimental studies at the optimum conditions where bentonite clay had adsorbed 57. 5 mg/L of Ni (II) and Kaolinite clay had adsorbed 26.5 mg/L of Ni (II). The exhausted adsorbents were collected into the filter paper air dried and stored for further desorption studies, 2g of exhausted adsorbent was taken to it 100ml of several extractants such as NH_4OH (1N), HCl (1N), EDTA (0.1M), H_2SO_4 (1N), HNO_3 (1N), NH_3-NH_4-Cl buffer and sodium acetate buffer were added individually. These beakers were left undisturbed for 24 hours, after 24hours of contact time the supernatant solution was taken and the final nickel concentration was determined using spectrophotometer.

RESULTS AND DISCUSSIONS

In the present study investigation on the adsorption tendency of nickel (II) using bentonite and kaolinite clay in a batch adsorption study were carried out, the effect of the various parameters studied were detailed below

Effect of pH

The pH influences the adsorption of metal ions by affecting the degree of ionization. In the current study on bentonite clay the optimum pH was found to be 8 at which the adsorption was found as 68% (Table 1). Above pH 9 the solution became turbid due to formation of metal hydroxides. As stated in literature (8) the increase in pH more equal balance between H_3O^+ and OH^- ions was observed and the positive charge strongly attracted by negative charged clay surface. Similar results were observed in another study, (9) which was reported that at low pH the adsorption nickel (II) was found to be low and this is probably due to coverage of clay surface with H_3O^+ ions. Increase in pH decreases the affinity of H_3O^+ ions on clay surface and increases the availability of adsorption sites to Nickel (II) ions. In case of kaolinite clay it was found to be 6, at lower pH values Ni (II) ions adsorption was affected. This can be explained by a possible competition between H^+ and Ni^{2+} ions for the available adsorption sites, because at low pH, the medium contains a high concentration of hydrogen ions. In one of the previous work, (10) sorption of nickel (II) was found to be increased with increase in pH. At low pH, nickel (II) sorption was very low. At low pH metal cations and protons compete for binding sites on adsorbent surface which results in lower sorption of metal ions. In the worked done by two other investigators (11, 12) reported at pH greater than 5, the adsorption of Ni (II) ions was found to be decreased because of the precipitation of nickel hydroxide resulted due to reaction between Ni (II) ions and hydroxide ions. It resembled the finding of the previous study, (13) where adsorption of Ni (II) was increased at pH 5 at which the adsorbent surface becomes negatively charged facilitating the attraction of positively charged metal ions.

Effect of Contact Time

The time dependent adsorption behaviour of nickel (II) on bentonite was measured by difference in the equilibrium time between the adsorbate and adsorbent. The percentage of adsorption increased gradually up to 60 minutes and was up to 70.5%. Thereafter, gradual and slow increase was observed up to 74% at 300 minutes (Table 2). The result indicated that adsorption reached the maximum within 60 minutes. Maximum adsorption at contact time 60 minutes can be attributed to availability of the adsorption sites on the surface of adsorbent. The experimental findings were similar with the findings of earlier studies (8, 14) where nickel (II) adsorption was observed on smectite clays.

The percentage adsorption of nickel (II) on kaolinite was found to have increased gradually with increasing contact time from 30 minutes to 300 minutes and observed to be 43.5% (Figure 2). The initial adsorption started slowly and the maximum uptake was found to have reached within 5 hours. This may be due to the decrease in adsorption sites on the clays that had interacted with the metal ions, but the adsorption rate depends on the metal ions which transported from the liquid phase to the actual adsorption sites. Adsorption of nickel (II), over 75% from aqueous solutions was found to be completed within first 20 minutes and equilibrium was reached at 120 minutes. This was because of rapid diffusion of metal ions form solution to the external surface of adsorbents to occupy the active surface (10). Adsorption of nickel (II) had achieved equilibrium at 120 minutes and increased up to 180 minutes, further increase in contact time up to 300 minutes resulted in decrease in adsorption and hence, 180 minutes of contact time was reported as optimum for nickel (II) adsorption (13).

Effect of Adsorbent dosage

The extent of adsorption at solid solution interface is a strong function of characteristics such as adsorbent dose, particle size etc (15). In the present study the adsorption of nickel (II) on bentonite reflects the above fact. The adsorbent dosage was varied between 20 and 100g per litre of nickel (II) solution, where the continuous increase in metal adsorption was observed with increasing dosage. The metal adsorption was found to be 68.5% at 100g of adsorbent dosage (Table 3). The reports (16) stated that the percentage adsorption of nickel (II) increased with the addition of more adsorbent with varying dosage of clay adsorbent from 0.1 to 0.7g was reported. The availability of more number of exchangeable sites might have resulted in enhanced uptake. The same results were also found in various studies of nickel adsorption on bentonite (17, 9).

Adsorption of nickel (II) on kaolinite in the present study was observed with adsorbent dose varied between 20 and 100g/L of metal solution and the continuous decrease in metal ion concentration with increasing dosage was observed initially. At adsorbent dose of 40g, 44.5% adsorption of Ni (II) was reported (Figure 3). Thereafter, the adsorption decreased gradually. This can be attributed to saturation of adsorption sites with the metal ions occupied on the surface of adsorbent. As reported in literature (13) there was an increase in adsorption of Ni (II) from aqueous solution onto Nigerian kaolinite with increasing adsorbent dosage. It has been reported that the maximum percentage of adsorption of Ni (II) ions was 15.54% using 0.5g kao1inite and 16.97% using 0.5g metakaolinite. The increase in percentage of adsorption of Ni (II) with increasing dose of adsorbent may be explained as availability of more surface area for metal ions to adsorb and this in turn resulted in increased the rate of adsorption was reported (13). Kinetic equilibrium studies on sorption of Ni (II) on Kaolinite and bentonite reported that sorption of Ni (II) was found to be increased with increasing adsorbent dose up to 2.5g and then there was no further increase of adsorption. The maximum adsorption of nickel (II) 90.3% at 100mg/L concentration was obtained with 2.5g of adsorbent dose of kaolinite was reported (10).

Effect of initial concentration

In the present study, nickel (II) the initial concentration was varied between 10 to 100ppm for both the clays. Maximum adsorption of 73% was observed at 10ppm and thereafter, it gradually decreased and was found as 57.5% at 100ppm on bentonite. The increase in concentration resulted in decrease in percentage of adsorption (Table 4). Similar results were observed in the literature (8). The increase in metal ion concentration results in saturation of the adsorption sites thereby decreasing the adsorption. Low initial concentration influences the ratio between the number of ions and available adsorption sites were reported (16). The adsorption is not dependent on initial concentration and in turn the increase in concentration decreases the adsorption because of competition between metal ions for adsorption sites was reported (17).

The adsorption was found to be 72.5% at 5ppm concentration on kaolinite (Figure 4). The increase in initial concentration was found to decrease the percent of adsorption gradually. This can be explained by the saturation between metal ions and available binding sites on the adsorbent. Similar findings were reported by sorption of Ni (II) ions onto Nigerian kaolinite (13). Varying initial metal ion concentration from 40mg/L to 200mg/L, volume of solution taken 100ml, 0.2g of adsorbent used at contact time 120 minutes pH 6 maintained for nickel (II) aqueous solution at room temperature (30±1 0C) was recorded. The metal ion adsorption per gram of adsorbent increased with the increase in initial metal ion concentration was reported (10).

The Freundlich isotherm plotted between log C_e and log q_e was obtained as linear plot over the experimental range of concentration for nickel (II) on both the clays, with the equation and correlation factor $y=0.7714x-1.4525$ and R^2 0.9925 for bentonite (Figure 5) and for kaolinite clay $y = 0.4923x - 0.998$, $R^2 = 0.9351$ respectively. The values of Freundlich constant K and 1/n were given in table 5, according to the work done (13) it was concluded that the high K value resulting in good value of 1/n allows the nickel (II) adsorption on bentonite with good fit into Freundlich model.

The Langmuir isotherm obtained for both the clays namely bentonite and kaolinite was linear plot plotted between Ce and Ce/qe. The adsorption data can be effectively explained by the Langmuir model with R^2 value of 0.968 for bentonite clay (Figure 5). The values Langmuir constant b and q_o have shown high interaction and more affinity of nickel II ions and bentonite clay. The similar findings can be observed in previous studies (19, 8). Many researchers have reported linear plots for both Langmuir and Freundlich isotherms in several studies (13, 12, 11 and10)

Percentage Adsorption of Ni (II) on a blend of clays:

As the soil system may contain both clays, in order to understand the behaviour of nickel in a stimulated system, a study has been carried out using the blend of bentonite and kaolinite clay. With the optimum conditions obtained for bentonite clay from the batch adsorption studies was varied on blend at various proportions. The percent of adsorption on 100% kaolinite for Ni (II) was found to be 26.5. At 20% bentonite and 80% kaolinite (B+K) the percentage of adsorption was found to be 64.5. With increasing percentage ratio of bentonite and kaolinite clay the percentage adsorption found to have increased. The influence of admix was clearly identified, at 40B:60K has shown 70.5%. (Table 6, Figure 7)

With the optimum conditions obtained for Kaolinite clay from the batch adsorption studies on blend at various proportions, the percent of adsorption on 100% Bentonite for Ni (II) 56.5%. The influence of admix was clearly witnessed for Ni (II) at 40K: 60B 76% of adsorption was noticed, at the clays proportion of 80B: 20K the percentage adsorption was found to be high as 71. 5% (Table 7, Figure 8)

A study concluded that increased adsorption of cobalt and nickel was observed with adsorbent clays of 100% zeolite, 100% bentonite and also with a mixture of 50%Z + 50%B was reported and from the study it was concluded that locally available natural clay minerals like zeolite, bentonite and mixture of both the clays can be used for the adsorption of heavy metal ions (20).

Desorption of Nickel (II) was carried out from exhausted adsorbents from the batch experimental studies of bentonite and kaolinite clay using different extracting solutions. Acid solution HCl, H_2SO_4 and HNO_3, with pH 1.14, 1.32 and 1.22 respectively possess an excess of proton capable of competing for sites and should also dissolve any precipitated hydrous oxides species. But it was not found that all of the sorbed metal ions extracted into the aqueous phases. The maximum removal observed for bentonite clay was 0.04943% with H_2SO_4 and in case of kaolinite clay it was found to be 0.25263 with HCl as the desorbing solution (Table. 8). The NH_3-NH_4Cl buffer has shown 0.01217% and 0.09868% of desorption for bentonite and kaolinite respectively. The other extracting solution like EDTA, sodium acetate buffer has shown very negligible amounts of desorption 0.00345%, 0.00518% respectively from exhausted bentonite clay, whereas it was reported to be 0.03643% and 0.04655% respectively in case of kaolinite clay. Desorption data indicates possibility of formation of inner sphere surface complexes between nickel (II) and both the adsorbent surfaces resulting in more strongly retained nickel (II).

TABLE: 1 EFFECT OF VARYING pH ON THE ADSORPTION OF Ni (II) USING BENTONITE AND KAOLINITE CLAY

Initial conc.: 50ppm
Contact time: 60 minutes
Adsorbent dosage: 100g/L

Clay	pH	Amt. Adsorbed (mg/L)	Ce (mg/L)	qe (mg/g)	% Adsorption
Bentonite	1	50	0	0.5	0
	3	23.5	26.5	0.235	47.0
	5	23	27	0.23	46.0
	8	34	16	0.34	68.0
Kaolinite	1	0	50	0	0
	2	15	35	0.15	30.0
	4	16	34	0.16	32.0
	6	19	31	0.19	38.0
	8	19.75	30.25	0.1975	39.5
	9	20.5	29.5	0.205	40.5

TABLE: 2 EFFECT OF VARYING CONTACT TIME ON THE ADSORPTION OF Ni (II) USING BENTONITE AND KAOLINITE CLAY

Initial Conc.: 50ppm
Adsorbent dosage: 50g/L

Bentonite clay
pH: 8

Kaolinite clay
pH: 6

Clay	Contact time (minutes)	Amt. Adsorbed (mg/L)	Ce (mg/L)	qe (mg/g)	% Adsorption
Bentonite	5	7	43	0.14	14.0
	10	12	38	0.24	24.0
	60	35.25	14.75	0.705	70.5
	120	35.75	14.25	0.715	71.5
	180	36.5	13.5	0.73	73.5
	240	36.5	13.5	0.73	73.0
	300	37	13	0.74	74.0
Kaolinite	30	8.5	41.5	0.17	17.0
	60	10.5	39.5	0.21	21.0
	120	10	40	0.2	20.0
	180	19	31	0.38	38.0
	240	18.25	31.75	0.365	36.5
	300	21.65	28.35	0.433	43.5
	360	16	34	0.32	32.0
	420	10	40	0.2	20.0

TABLE: 3 EFFECT OF VARYING ADSORBENT DOSAGE ON THE ADSORPTION OF Ni (II) USING BENTONITE AND KAOLINITE CLAY

Initial conc.: 50ppm

Bentonite clay
pH: 8
Contact time: 60 minutes

Kaolinite clay
pH: 6
Contact tine: 5 hours

Clay	Dosage (g)	Amt. Adsorbed (mg/L)	Ce (mg/ L)	qe (mg/g)	% Adsorption
Bentonite	20	9	41	2.05	18.0
	40	16	34	0.85	32.0
	60	27	23	0.38333	54.0
	80	28.75	21.25	0.26563	57.5
	100	34.25	15.75	0.1575	68.5
Kaolinite	20	17.5	32.5	1.625	35.5
	40	22.25	27.75	0.69375	44.5
	50	23.5	26.5	0.53	47.0
	60	22.25	27.75	0.4625	44.5
	80	20.5	29.5	0.36875	41.0
	100	18	32	0.32	36.0

TABLE: 4 EFFECT OF VARYING INITIAL CONCENTRATION ON THE ADSORPTION OF Ni (II) USING BENTONITE AND KAOLINITE CLAY

Bentonite clay
pH: 8
Contact time: 60 minutes
Adsorbent dosage: 100g/L

Kaolinite clay
pH: 6
Contact time: 5hours
Adsorbent dosage: 40g/L

Clay	**Conc. (ppm) Ci**	**Amt. Adsorbed** (mg/L)	**Ce** (mg/L)	**qe** (mg/g)	**log Ce**	**log qe**	**K** (min^{-1})	**Δ G**	**Ci / Ce**	**Ln** Ci / Ce	**Ce / qe**	**% Adsorption**
Bentonite	10	7.3	2.7	0.073	0.4313	-1.136	676.72	-293.84	3.703	1.309	36.98	73.0
	20	14	6	0.14	0.7781	-0.853	622.27	-270.20	3.333	1.203	42.85	70.0
	25	17.125	7.875	0.171	0.8962	-0.766	597.05	-259.25	3.174	1.159	45.98	68.5
	30	20.4	9.6	0.204	0.9822	-0.690	588.91	-255.71	3.125	1.139	47.05	68.0
	40	26.5	13.5	0.265	1.1303	-0.576	561.39	-243.76	2.962	1.086	50.94	66.25
	50	33	17	0.33	1.2304	-0.481	557.58	-242.11	2.941	1.078	51.51	66.0
	60	39.498	20.502	0.394	1.3117	-0.403	555.00	-240.99	2.926	1.073	51.90	65.83
	100	57.5	42.5	0.575	1.6283	-0.240	442.24	-192.03	2.352	0.855	73.91	57.5
Kaolinite	5	3.625	1.375	0.090	0.1383	-1.042	667.24	-289.72	3.636	1.290	15.17	72.5
	15	10.2	4.8	0.255	0.6812	-0.593	588.91	-255.71	3.12	1.139	18.82	68.0
	20	12.3	7.7	0.307	0.8864	-0.512	493.33	-214.21	2.597	0.954	25.04	61.5
	30	16.8	13.2	0.42	1.1207	-0.376	424.32	-184.24	2.272	0.820	31.42	56.0
	40	18.6	21.4	0.465	1.3304	-0.332	323.28	-140.37	1.869	0.625	46.02	46.5
	50	22	28	0.55	1.4471	-0.259	299.67	-130.12	1.785	0.579	50.90	44.0
	60	23.1	36.9	0.577	1.5670	-0.238	251.25	-109.09	1.626	0.486	63.89	38.5
	100	26.5	73.5	0.662	1.8662	-0.178	159.12	-69.09	1.360	0.307	110.94	26.5

TABLE: 5 ADSORPTION ISOTHERMS CONSTANT FOR THE ADSORPTION OF Ni (II) USING BENTONITE AND KAOLINITE CLAY

Adsorbent (clay)	**Freundlich Constant**		**Langmuir Constant**	
	1/N	**K** (mg/g)	**b** (L/mg)	**Q_o** (mg/g)
Bentonite	0.7751	28.35	0.0220	1.177
Kaolinite	0.4926	9.95	0.0850	0.875

TABLE: 6 PERCENTAGE ADSORPTION OF Ni (II) WITH A BLEND OF BENTONITE AND KAOLINITE CLAY

pH: 8
Contact time: 1 hr
Adsorbent dosage: 100 g/L
Initial Concentration: 50 mg/L

S.No.	**% Blend**	**% Adsorption**
1	100 K	26.5
2	20 B + 80 K	64.5
3	40 B + 60 K	70.5
4	60 B + 40 K	68.5
5	80 B + 20 K	63.5
6	100 B	67.5

TABLE: 7 PERCENTAGE ADSORPTION OF Ni (II) WITH A BLEND OF KAOLINITE AND BENTONITE CLAY

pH: 6
Contact time: 5 hr
Adsorbent dosage: 40 g/L
Initial Concentration: 50 mg/L

S.No.	**% Blend**	**% Adsorption**
1	100 B	56.5
2	20 K + 80 B	71.5
3	40 K + 60 B	76.0
4	60 K + 40 B	72.0

5	80 K + 20 B	71.5
6	100 K	44.5

TABLE: 8 DESORPTION OF Ni (II) FROM EXHAUSTED ADSORBENT OF BENTONITE AND KAOLINITE CLAY USING DIFFERENT EXTRACTING SOLUTIONS

Contact time: 24 hrs
Dosage: 2g/100 ml

S.No.	Extracting Solution	pH	% Ni (II) Desorbed	% Ni (II) Desorbed
			Exhausted Bentonite Clay	Exhausted Kaolinite Clay
1	HCl (1N)	1.14	0.04002	0.25263
2	H_2SO_4 (1N)	1.31	0.04943	0.24210
3	HNO_3 (1N)	1.22	0.04915	0.22631
4	EDTA (0.1M)	4.97	0.00345	0.00404
5	NH_4OH (1N)	10.41	0.00734	0.03643
6	Sodium Acetate Buffer	4.61	0.00518	0.04655
7	NH_3-NH_4Cl Buffer	10.17	0.01217	0.09868

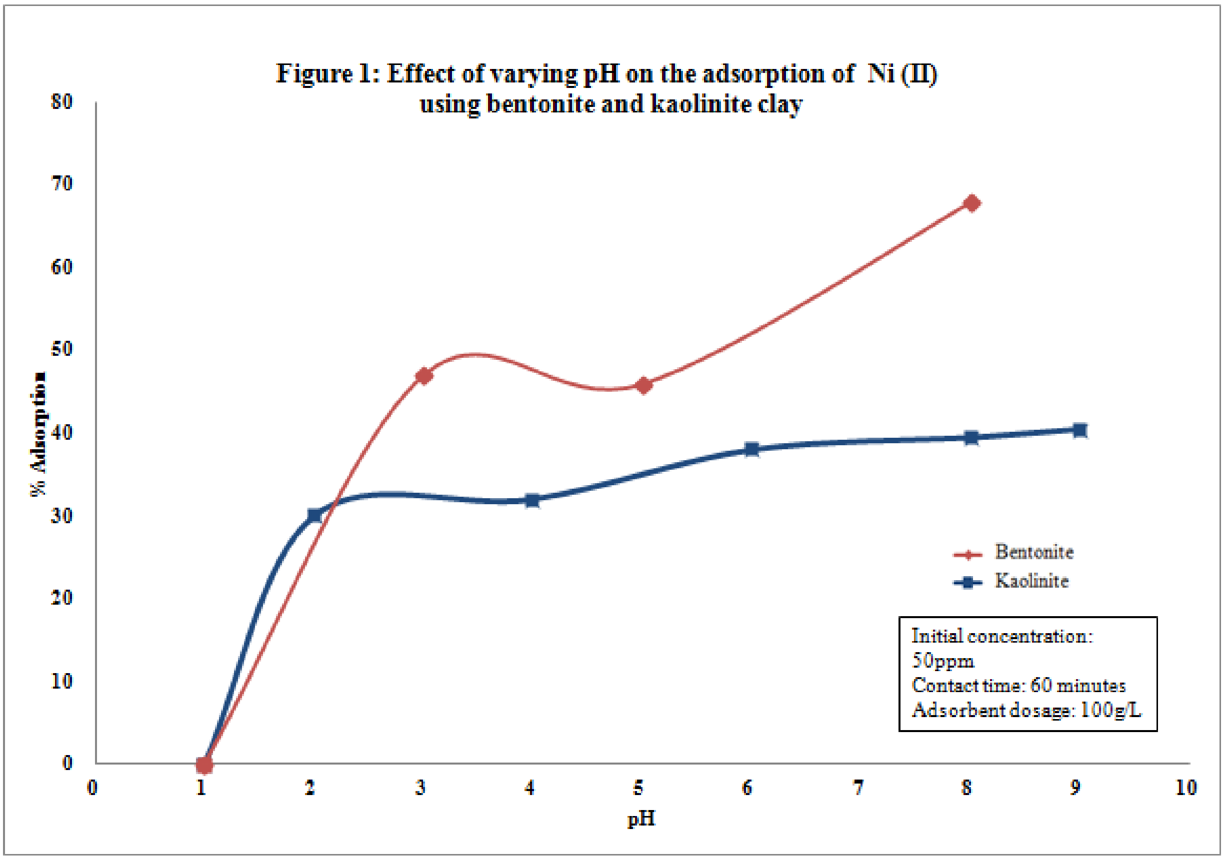
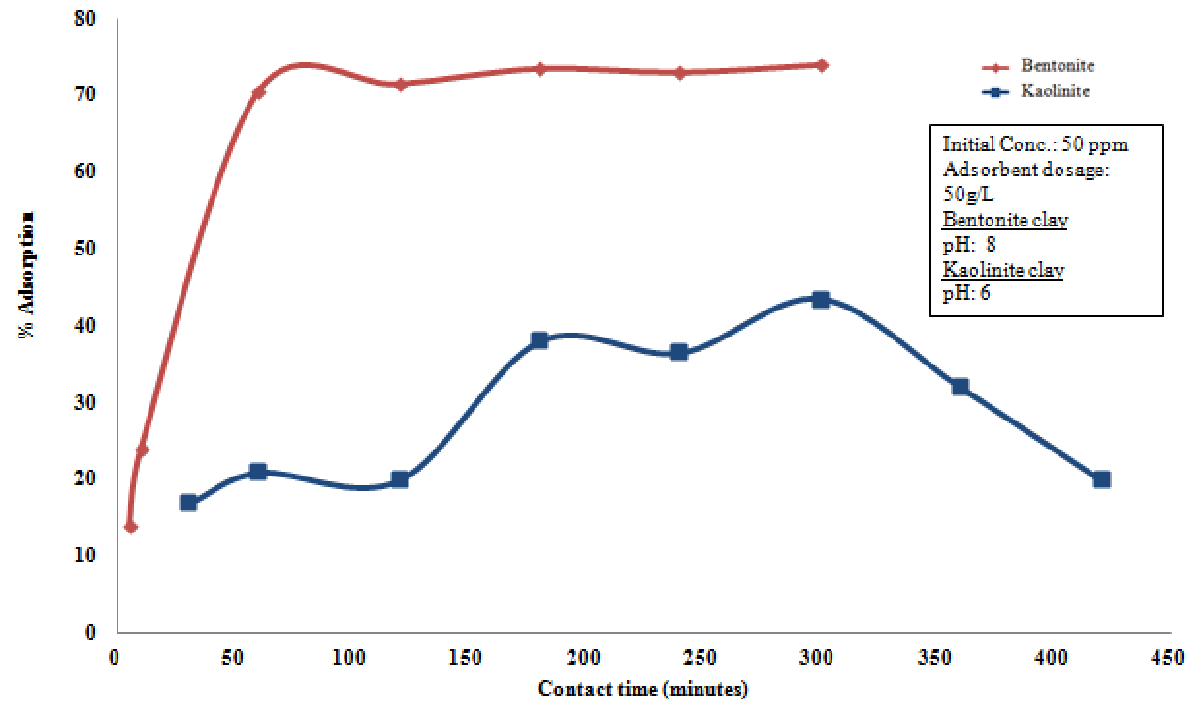


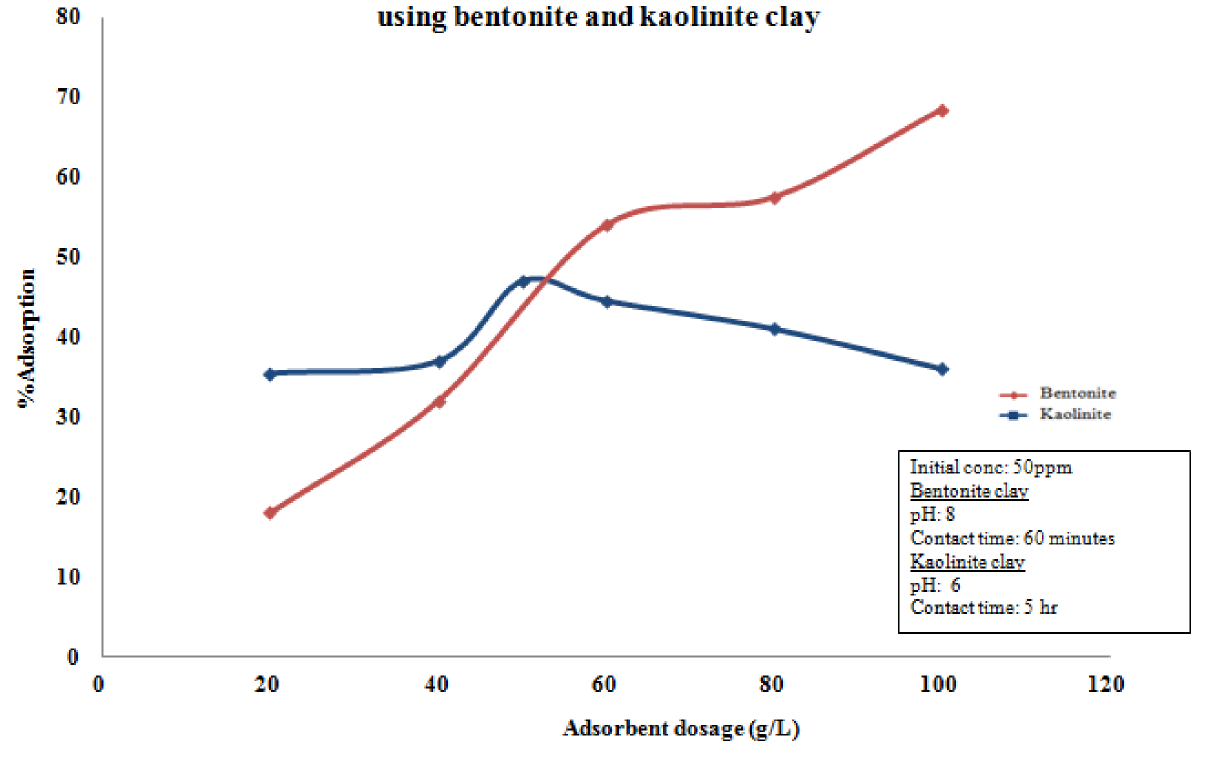
Figure 1: Effect of varying pH on the adsorption of Ni (II) using bentonite and kaolinite clay

Figure 2: Effect of varying contact time on the adsorption of Ni (II) using bentonite and kaolinite clay



Initial Conc.: 50 ppm
Adsorbent dosage: 50g/L
<u>Bentonite clay</u>
pH: 8
<u>Kaolinite clay</u>
pH: 6

Figure 3: Effect of adsorbent dosage on adsorption of Ni (II) using bentonite and kaolinite clay



Initial conc: 50ppm
<u>Bentonite clay</u>
pH: 8
Contact time: 60 minutes
<u>Kaolinite clay</u>
pH: 6
Contact time: 5 hr

Figure 4: Effect of initial concentration on adsorption of Ni (II) using bentonite and kaolinite clay

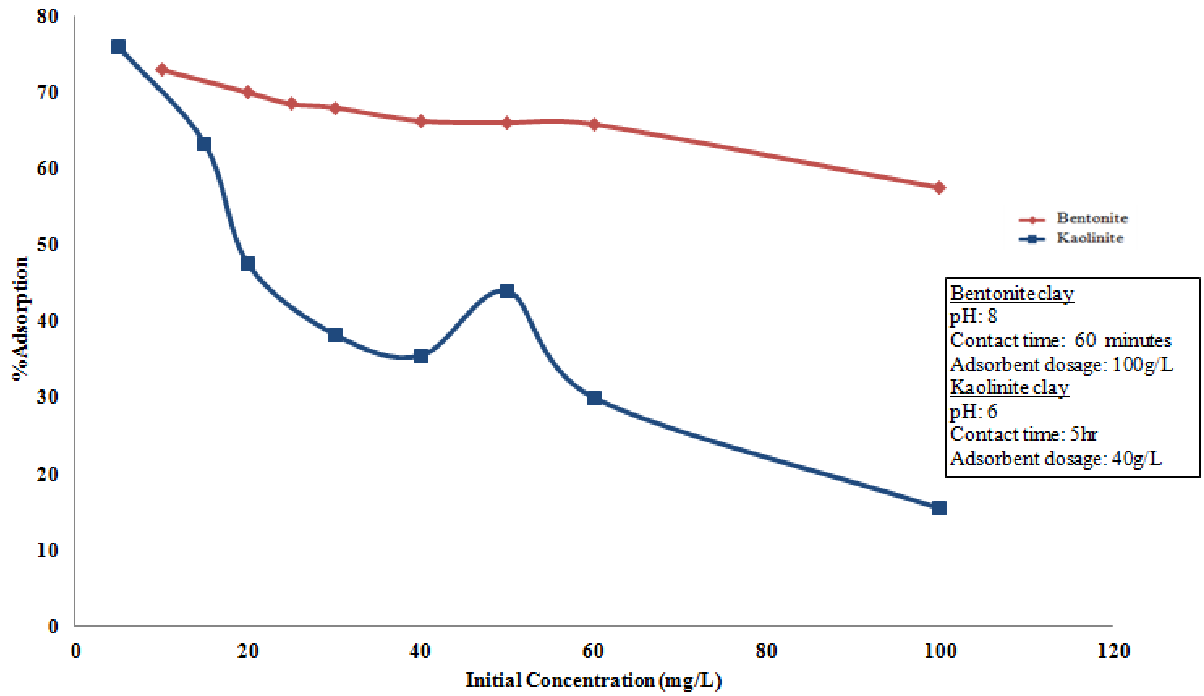


Figure 5: Freundlich Plot of Log Ce Vs Log qe for the Adsorption of Ni (II) using bentonite and kaolinite clay

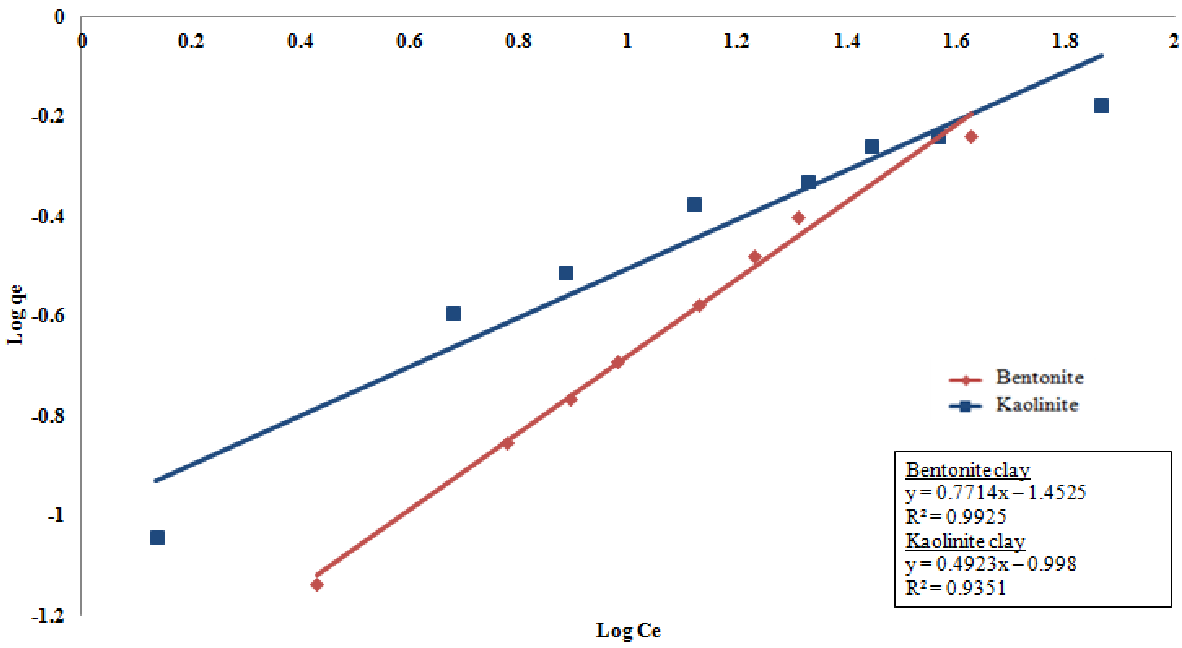
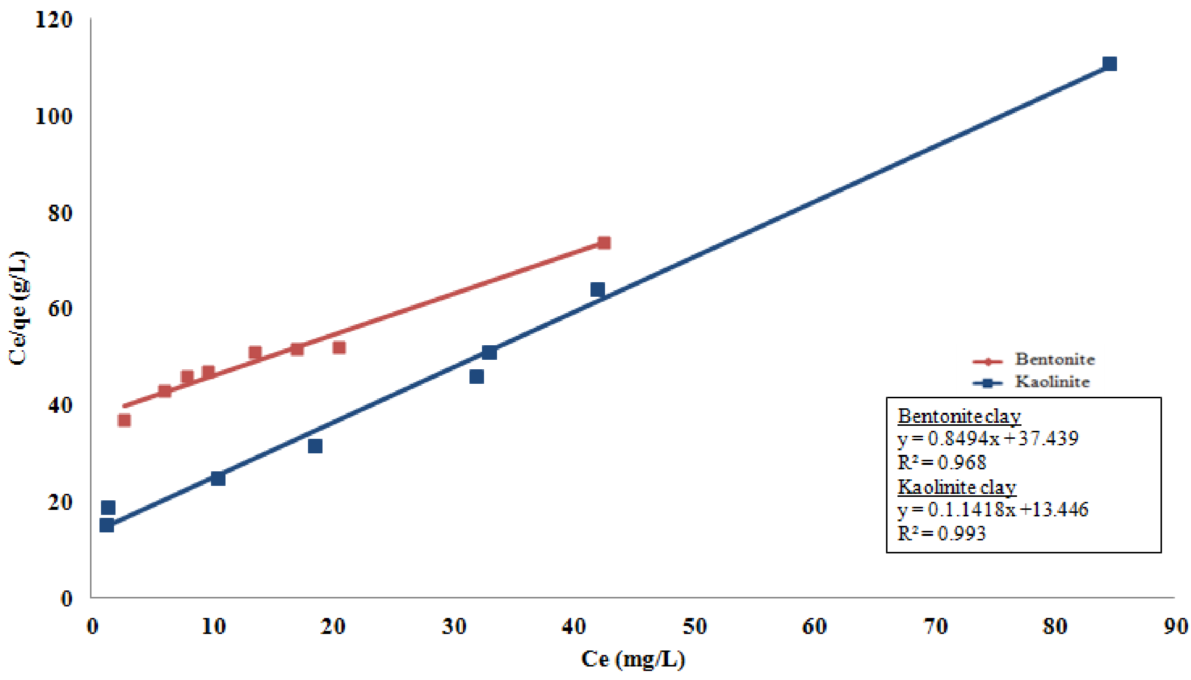


Figure 6: Langmuir Plot of Ce Vs Ce/qe for the Adsorption of Ni (II) using bentonite and kaolinite clay



CONCLUSION

The results showed that the adsorption of Ni (II) in comparative study on both adsorbents bentonite and kaolinite clay, we have noticed that the adsorption percentage onto the bentonite clay is more than the kaolinite clay, there are several factors affecting the adsorption of metals ions onto Bentonite clay, however, the increase in pH from 1 to 8, plays a significant role on the adsorption of nickel (II) reporting the maximum adsorption at pH 8 with bentonite clay whereas in case of kaolinite clay adsorption is seen at pH 6, For both the adsorbents contact time was varied up to 360 minutes and a maximum of 70. 5 % adsorption was observed at 60 minutes for bentonite clay whereas kaolinite clay at 300 minutes it was reported to be 43.5%. On increasing the initial concentration up to 100 mg/L in case of nickel (II) showed 57.5% adsorption on bentonite clay, whereas incase of kaolinite clay it was 26.5%. The adsorption behaviour modeled using Freundlich and Langmuir isotherms were found to be linear over the experimental range of concentration. The blend and desorption study can help understand the leaching of metals in soil environment.

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