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STUDY OF ADSORPTION OF ARSENIC METAL FROM AQUEOUS SOLUTION THROUGH LOCAL ADSORBENT SAW DUST

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ABSTRACT

Saw dust has been prepared as new adsorbent experiments have been conducted to investigate adsorption characteristic for arsenic metal. Effects of contact time, initial concentration pH etc. have been studied for the removal of arsenic. An empirical relationship has been obtained to predict the percentage of arsenic at any time for known values of adsorbent and initial adsorbent concentration under observed test conditions. The adsorption process was observed to follow the kinetic order. The optimum pH was exhibited to be 6.0. The adsorbed arsenic was disrobed quantitatively by 0.5 MHClsolutions and the adsorbent could be reused for three cycle consecutively.

KEYWORDS: Arsenic,Indo-NepalBorder,Batchexperiment, adsorbentconcentration

Arsenic occurrence in the aquatic environment, its toxicity especially towards the health hazards are a established facts. Although it has a glorious history especially in the field of science, technology and medicine field, still it notoriety in the form of slow poison is a worldwide concerned today. Arsenic removals from the aquatic environment either from various waste bodies or from ground water of the indo-Nepal boarder include various technologies including several comprehensive waste treatment strategies (Nurul et al., 2006). Most of these methods require high capital cost, skilled supervision, post expenditure and removal of waste toxic byproducts. Increased awareness on the toxicity of metal including arsenicprompted the authority concern the implementation of strict regulation for it disposal causing traditional treatment processes such as ion exchange reverse osmosis or membrane system etc are now becoming component in integrated systems that produce effluent of better quality while allowing for the recovery and reuse of metal (Brierly,1990). Immobilized chelation process for the removal of toxic arsenic has become an important option in the integrated approach to aqueous waste treatment. This process incorporates the principle of metal coordination to traditional ion-exchange technology thus effecting major changes in the application of the adsorbents (Hudson, 1986). In an increasing search for low cost adsorbents various substances such as ablecmoschusesculentus saw dust tea leaves, fly ash has been reported. Now day arsenic has received a great deal of attention as it is one of the worst contaminated pollutant which can cause considerable damage to human and aquatic life even at trace level. Dangerous arsenic concentration in aquatic medium is now a worldwide problem. High arsenic concentrations have been reported recently from various countries including developed country like USA, China. India is not far behind and apart from Bangladesh which tops the list of effected countries its one state which is just bordering Bangladesh, i.e. west Bengal. Arsenic is ubiquitous pollutant and is a worldwide problem. Adsorption is evolving as a frontline of defense. Selective adsorption utilizing biological materials, mineral oxides activated carbons etc has generated increasing excitement.

MATERIALS AND METHODS

Preparation of Adsorber

Common saw dust was collected from the local saw mills and brought to the laboratory in bucket. It was

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washed by distilled water three to four times to remove the waste soluble particles .It was dried at about 100^0c and sieved through 140-180 mesh size. The saw dust powder (50gm) was refluxed with 18 gm. NaCl, 2-amino naphthol 3,6 disolphonic acid, 12.5g melamine and 50ml HCHO and stirring was done continuously for 10 minutes. The product was washed with / demineralized water several times and later on dried in sun.

Batch Experiment

Batch adsorption test was performed by shaking 0.5gm of saw dust with 250ml aqueous of metal ion for 4 hr at room temperature. The pH of the solution was adjusted using 0.1 MNaOH and 0.1 MHCl. A 5ml aliquot of supernalent solution was withdrawn with pipette EDTA titration process.

RESULTS AND DISCUSSION

Effect of Contact Time

Effect of contact time and initial concentration on adsorption of arsenic by the saw dust has attained in 3 hours. A contact time of 3 hours was used in all subsequent adsorption tests.

Batch Experiment

Batch experiments were conducted to investigate the parametric effects of adsorbent concentration (Ws) and initial adsorbate concentration (Co) on adsorption. For intial concentration of arsenic: 50,100,200 and 400 mg L^{-1}, the remaining arsenic was determined at different contact times by varying the adsorbent dosages 2,4,6 and 10 g L^{-1} . The percentage removal of arsenic for the above stated initial adsorbate concentration (Co) and adsorbent concentration (Ws) values are shown in fig 1a to 1b. The rate of adsorption was observed within 3 hours. At any time for a given Co valve the percentage of arsenic removal increased with increase in Ws. The equilibrium time was independent of adsorbent concentration. The similar type of curve at each initial concentration of arsenic show that the percentage removal decreases with increasing initial concentration. This may be due to the fact for a fixed adsorbent dose, the total adsorption sites are limited resulting in a decrease in percentage removal corresponding to an increased initial adsorbent concentration. The smooth curve of percentage removal verses time (fig.1a) suggests the possibility of monolayer coverage of arsenic on the outer surface of the adsorbent.

The experimental data shown in Fig.1a would be fitted by a relationship i.e.

t/R = a + bt ……………………..(i)

Where R = percentage removal at time t

a& b =co-efficients

The above data are enumerated in table 1.

The average values of a and Ws can be related by the following:

a = 1/c+dws ………………….. (ii)

Where c & d = coefficients

The values of the above coefficient are found as 4.75 and 0.56 respectively. The validity of fitting the date to the above equation is determined through regeneration error line (fig. 2). The value of 'b' increases with Co for all values of Ws in table 2.

Effect of pH

The adsorption capacity determined at varying pH (fig.1b) exhibited that capacity increases from pH 2 to 8. Poor adsorption at lower pH may be due to higher concentration of H^+ competing ions. Further at higher pH the decrease in adsorption may be explained due to the formation of soluble hydroxy complexes. The pH of the aqueous solution is a controlling factor in the adsorption process. Thus the role of H_2 ion concentration was examined at pH values of 2, 4, 6, 8 & 10.

Effect of contact time and initial concentration on adsorption of arsenic by the saw dust was attained in 3 hours. (Ajmal et al., 1998) reported similar results for adsorption of saw dust in the removal of copper (II) from industrial wastes. However further increase in contact time does not increase the uptake due to deposits of some ions on the adsorbent materials (Piekos and Paslawska, 1990).Successful application of the adsorption techniques demands innovation of cheap, non-toxic easily and locally available material. Bio-adsorbents meet these requirements. Knowledge of the optima conditions would formulate a better design and modelling process (Barkin and Pailles, 2000).The effect of some major parameters like contact time pH etc. was instigated from kinetic view print.

Thus the ability of saw dust to absorb arsenic from aqueous media has been demonstrated. The extent of removal depends upon the initial concentration, pH and temperature (Khare et al., 1987; Raji and Anirudhan, 1996). An empirical relationship has been established which can predict the percentage removal of arsenic at any time for a given adsorbent dose and given initial concentration. The efficiency of the sorption of fluoride ion is affected by pH, contact time, adsorbent dose, type and size of adsorbents. It is observed that removal of metallic ion increase with an increase in the amount of adsorbent(Table-2).It has been further observed that-

(i) Non-conventional adsorbents are relatively cheaper compared to conventional ones and are easily available resulting in saving in cost.

(ii) Non-conventional adsorbents require simple alkali/or and acid treatment for the removal of lignin before their application and to increase efficiency.

(iii) Since the cost of these adsorbents in relatively low and as such they can be used once and discarded.

(iv) Non-conventional adsorbents require less maintenance and supervision.Separation is possible to segregate the non-conventional adsorbents from the effluents before their disposal.

(v) The non-conventional adsorbents can be disposed off easily and safely. Used adsorbents can be reused as a filter material is low laying areas and hence their disposal does not pose any serious problem.

CONCLUSION

In an increasing search for low cost adsorbents grafted saw dust has established successfully as one of the cheapest adsorbents that could be used for the removal of arsenic ions over a wide range of concentration. Treated adsorbents can be disposed of safely by burning after use. They are locally available and hence involve no expenditure on transportation and have a very low cost pre-treatment. There is no need to regenerate the exhausted treated adsorbents as they are available abundantly, easily, cheaply and locally.

Table 1:Values of co-efficient a&b for different values of Ws& Co.

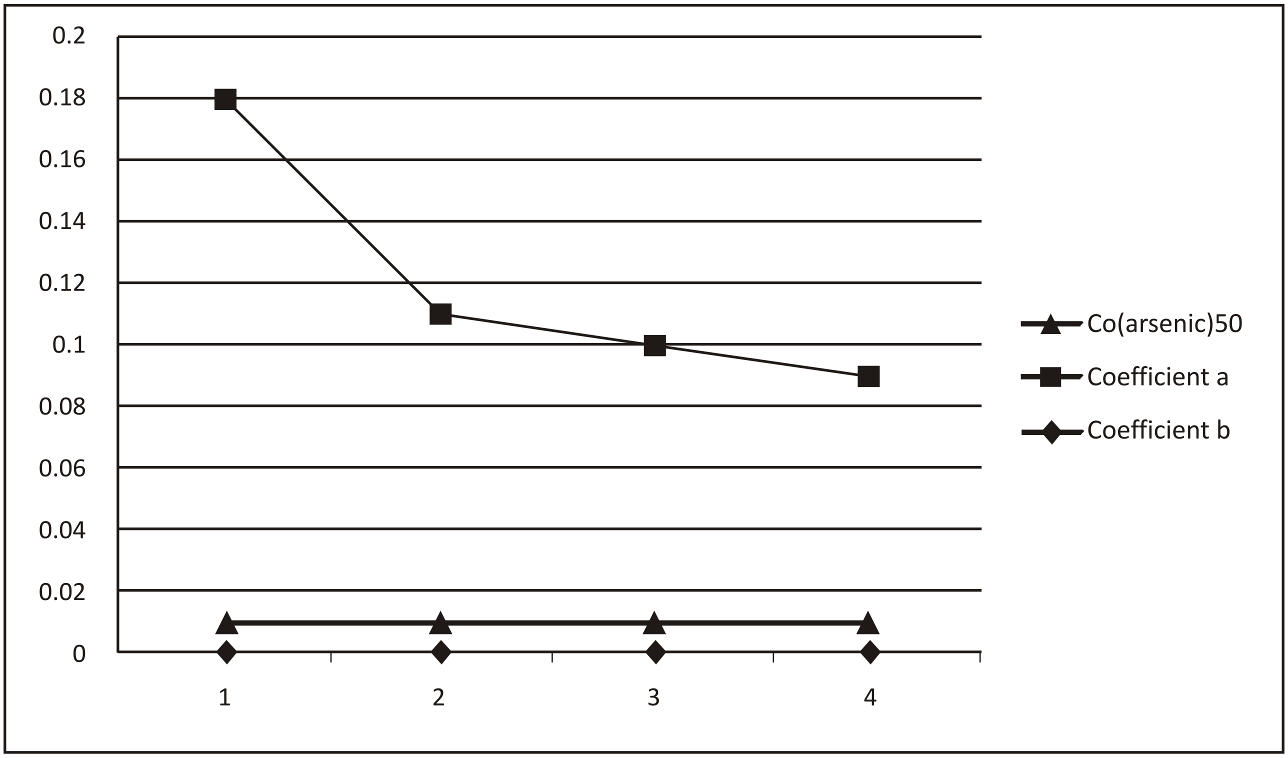
DOSE OF ABSORBENT (SAW DUST), Ws. (gL^{-1})

Initial arsenic concentration Co (mgL^{-1})	**2**	**4**	**6**	**10**
50	a-0.1785	a-0.1135	a-0.1068	a-0.0975
	b-0.0110	b-0.0108	b-0.0104	b-0.0112
100	a-0.1750	a-0.1385	a-0.1030	a-0.0970
	b-0.0180	b-0.0108	b-0.0108	b-0.0116
200	a-0.1785	a-0.1380	a-0.1120	a-0.0885
	b-0.0128	b-0.1775	b-0.0125	b-0.0118
400	a-0.2275	a-0.1795	a-0.1385	a-0.1130
	b-0.0108	b-0.0128	b-0.0112	b-0.0118

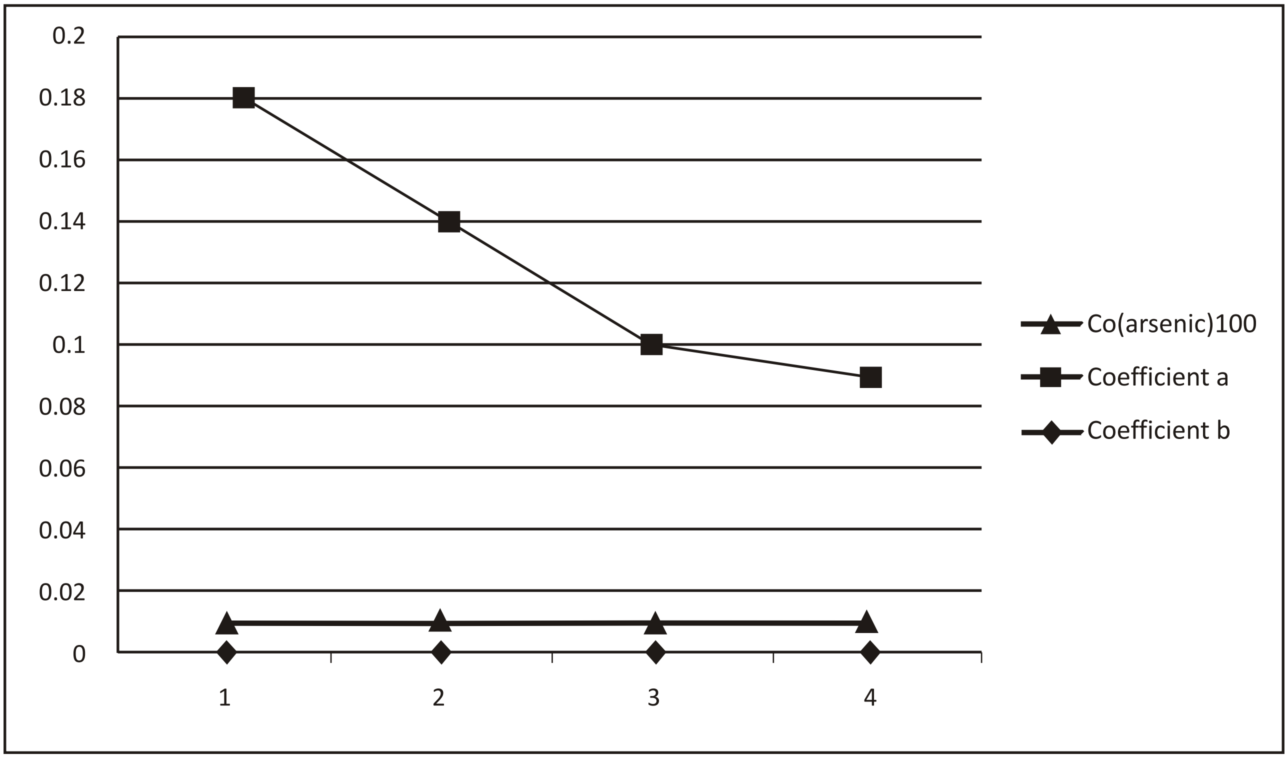
Table 2: Values of co-efficient e and f for different values ofWs.

Dose of absorbents Ws (gL^{-1})	**e**	**f**
2	2275.85	72.35
4	1577.49	75.95
6	1288.68	82.15
10	0628.75	85.25

Figure: 1a

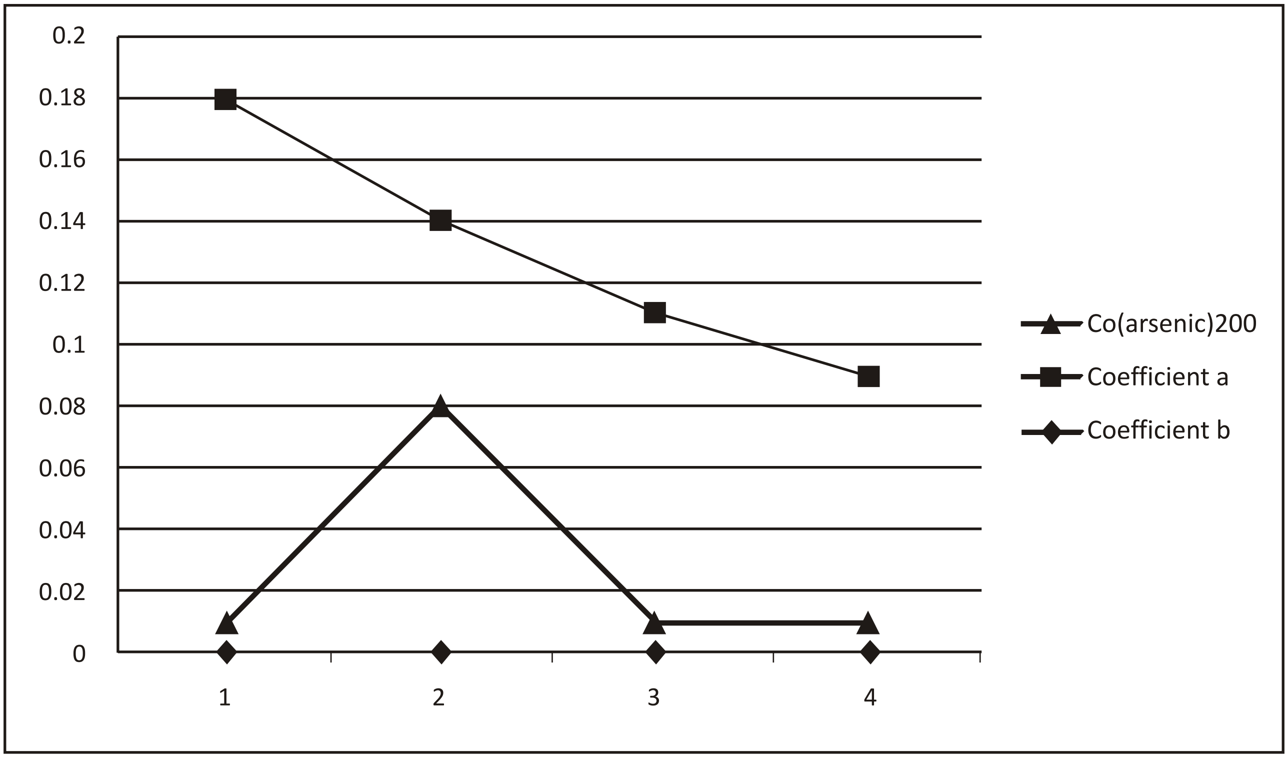


Adsorbent dose 2, 4,6,10 g L^{-1}AND pH = 6.0 (Arsenic ion)

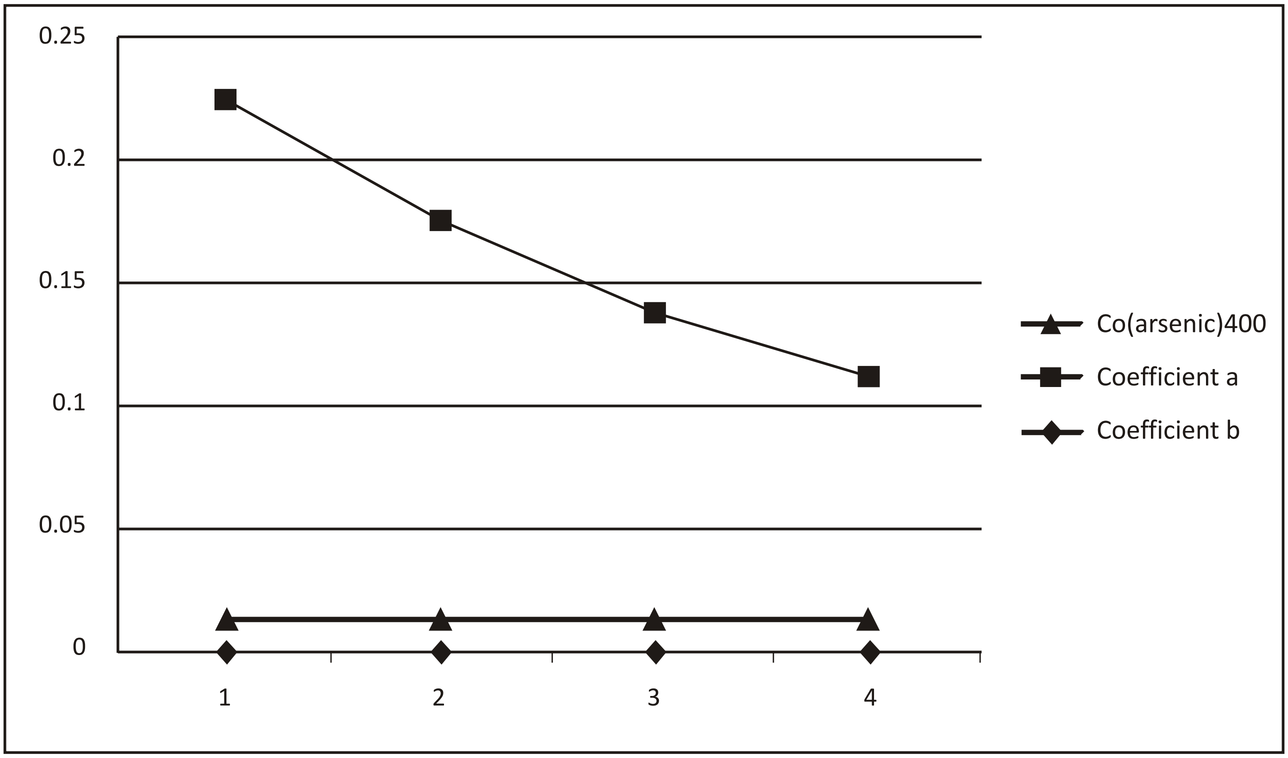


Adsorbent dose 2, 4,6,10 g L^{-1} AND pH = 6.0 (Arsenic ion)

Figure: 1b

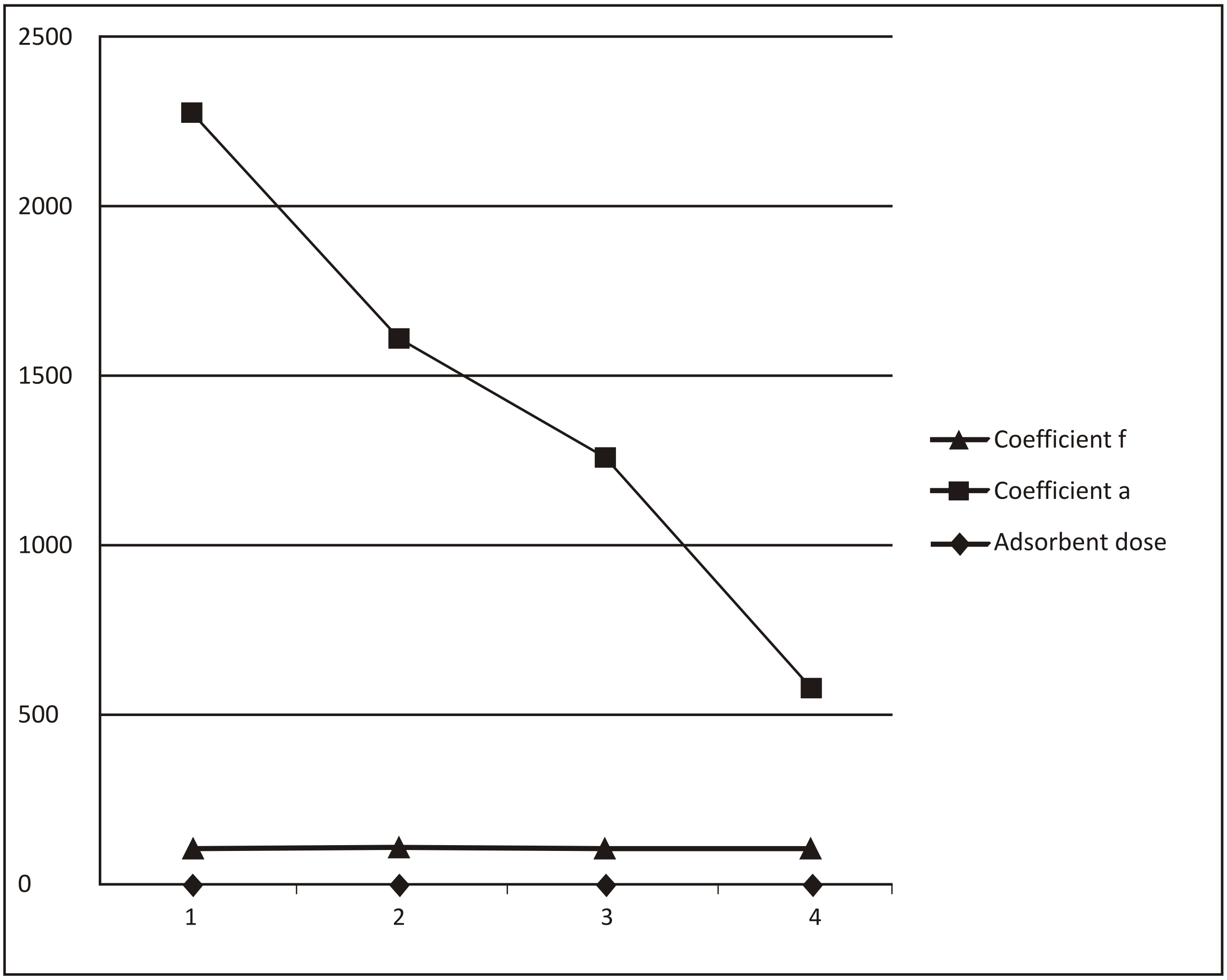


Adsorbent dose 2, 4,6,10 g L^{-1} AND pH = 6.0 (Arsenic ion)



Adsorbent dose 2, 4,6,10 g L^{-1}I AND pH = 6.0 (Arsenic ion)

Figure: 2



Values of co-efficient e and f for different value

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