Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Advances in Applied Science Research, 2016, 7(4):185-189

ISSN: 0976-8610
CODEN (USA): AASRFC

Adsorption studies for removal of organochlorine pesticides using modified unsaturated polyester resin

Pradip Dave and S. V. Patel*

Chemistry Department, Sir P. T. Science College, Modasa-383315. Gujarat (India)

ABSTRACT

Organochlorine pesticides in water are of great concern due to their stable nature and chronic adverse effect on human health as well as on environment. Organochlorine pesticides such as DDT, aldrin, dialdrin etc. were commonly used in agricultural and some dieses preventing activities. Also surface water which is used as drinking water contains highly concentrate values of these pesticides becomes a choice for its adsorption studies. Hence, the mixture of polymer and other natural low cost materials have been employed for removal of organochlorine pesticides from pharmaceutical waste. Effect of these organochlorine pesticides was investigated by different adsorption parameters such as contact time, pH value, and concentration. Also the

Keywords: Organochlorine pesticide, Adsorption, Sulfonated polyester resin, Langmuir and Freundlich model

---

INTRODUCTION

In developing countries surface water sources are subjected to pollution by organochlorine pesticides, where the safety of surface water sources is likely related to human health and the environment [1-3]. Organochlorine pesticides currently being used as pesticides have been of great concerned with a wide range of adverse effect on human health and environmental which causes many dieses such as Depression and neurological deficits, Diabetes, Cancer, Respiratory diseases, Women specific disorders and other multiple diseases [4-8]. Pesticides are hazardous and toxic in nature and persevere in the surface water environment for many years after their application. In many developing countries, the use of organocholrine pesticides have banned because they pollute the surface water system which generally base of drinking water.

A wide range of technologies are accessible to control water pollution such as coagulation-flocculation, ozonization, ion exchange, biodegradation, photodegradation, advanced oxidation processes and different adsorption processes [9-15]. However, use of most processes often restricted because they require extensive economic contribution. Among various available water treatment technologies, adsorption is accepted as one of the most adequate processes because its advantages over other conventional process such as low cost, effectiveness, easy to use and simplicity of design. Adsorption process has been widely applicable in water pollution control as it able to remove different types of pesticides[9,12,14,16,17].Activated carbon is considered a universal adsorbent for the removal of diverse types of pesticides from water. However, their use is often limited for small scale industries in developing countries due to cost factors. Attempts have been made to replace this high cost activated carbon by inexpensive adsorbents utilizing numerous agro-industrial and pharmaceutical waste [18,19]. The use of pharmaceutical waste materials as inexpensive adsorbents is attractive due to their advantages such as reduction of costs and sustainable environmental

protection. Numerous inexpensive adsorbents used comprise rice husk, saw dust, bamboo, cactus, coconut shell, peanut shells, olive stones, avocado stones, date stones, straw, and bagasse [20-23].

The purpose of this work is to develop an inexpensive method that can be used in removing pesticide pesticides. So the present paper deals with removal of the pesticide pesticides by applying polymer adsorbent with natural adsorbent.

The area in which the modification of USPE towards the organochlorine pesticide adsorbents has not been much explore so far. So it has been thought to explore the field of sulfonated-modified USPE resin as organochlorine pesticide adsorbents.

MATERIALS AND METHODS

Materials:

All the chemicals used were of analytical grade which were used without further purification. Various newly prepared sulfonated-modified USPE resin (**Scheme-1**) taken was already synthesized in our pervious publication [24].Effluent sample **(E1)** containing organochlorine pesticide taken for study was collected from Vatva GIDC, which is situated in Gujarat state of India. Sulfonated-modified USPE resin was mixed in different composition with Animal charcoal, Saw dust, and Rice husk to prepare new blends **(B1-B3)**, which is subjected to test for removal of organochlorine pesticides from effluents samples.

Following **Table-1** Show the composition details about various adsorption materials with S-MUSPE-resin.

Table-1 Composition of blends used as adsorption materials

No.	S-MUSPE Resin	Animal charcoal	Saw dust	Rice husk
B1	60	10	10	20
B2	60	10	15	15
B3	60	10	20	10

Batch adsorption experiments

Batch equilibrium adsorption experiments were carried out in 1000 ml flasks containing organochlorine pesticide aqueous solution at 25^0C.Blends containing S-MUSPE-resin was added to the effluent**(E1)** with concentration of 250 mg/L for the determination of adsorption capacity. At different time intervals of every 2 hours till 24 hours at pH = 6, the pesticide concentration in the effluents were determining by evaporated to dryness. The pesticide concentration was analyzed calorimetrically with a spectrometer by the measurement of absorbance at the maximum absorption wavelength. In the equilibrium adsorption isotherm experiments, a fixed amount of sorbent (0.25 g) was contacted with dyes organochlorine pesticides having different composition as per **Table 1**.

We investigated the effect of adsorption on prepared blends B1-B3 for the parameters such as contact time, pH and initial organochlorine pesticide concentration.

RESULTS AND DISCUSSION

Effect of the contact time and pH

The initial organochlorine pesticide concentrations in solution were determined at different times from initial solutions of different concentration and a sorbent dosage of 0.25 g/L. According to the adsorption studies, which were carried out at different pH values, the optimal pH value was determined as 6**(Figure-1)**and all experiments were carried out in triplicate at this pH value. This result was compatible with other results reported previously in the literature. Furthermore, it has also been reported that the pH values of the basic organochlorine pesticide from different industries are below 6.5 pH. Also results**(Table-2)** shows that the adsorption capacities for organochlorine pesticide were increased with the increase in adsorption time. After the equilibrium adsorption time of 8 h, no change in adsorption capacities were observed, which can be due to saturation or repulsive force among the organochlorine pesticide. The evaluated data from **Table-2** clearly shows that all three prepared blends have almost similar adsorption capacity. Hence it suggests that the prepared S-MUSPE-resin has good adsorption capacity and can be used as effective adsorption material for the removal of organochlorine pesticides.

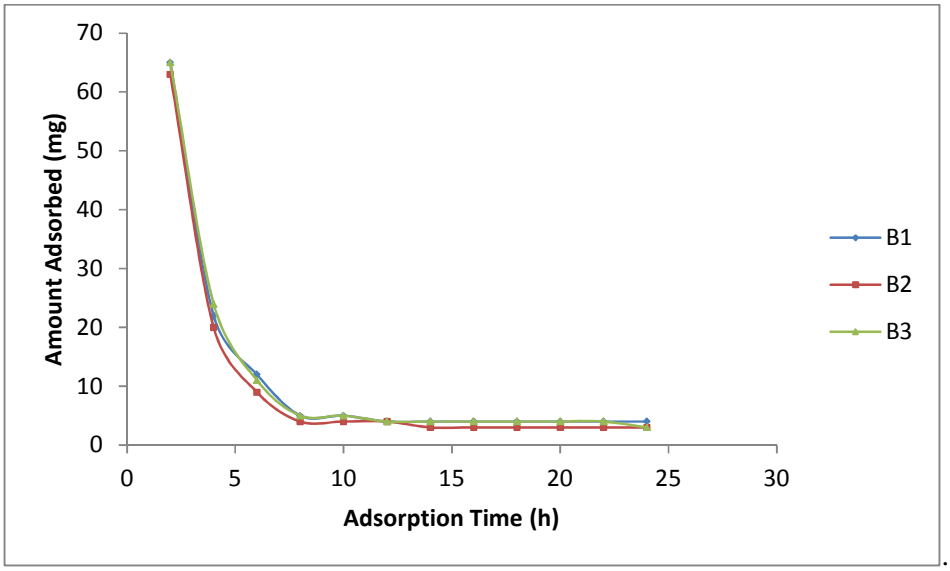

Figure-1 Effect of adsorption on effluent (E1) at different time

Table-2 Removal of organochlorine pesticide from effluent (E1) using blends containing S-MUSPE-resin

Time	Pesticide Concentration in E1 after evaporate to dryness in mg/L		
	B1	B2	B3
Initial	72 mg	72 mg	72 mg
02 hrs	65 mg	63 mg	65 mg
04 hrs	22 mg	20 mg	24 mg
06 hrs	12 mg	9 mg	11 mg
08 hrs	5 mg	4 mg	5 mg
10 hrs	5 mg	4 mg	5 mg
12 hrs	4 mg	4 mg	4 mg
14 hrs	4 mg	3 mg	4 mg
16 hrs	4 mg	3 mg	4 mg
18 hrs	4 mg	3 mg	4 mg
20 hrs	4 mg	3 mg	4 mg
22 hrs	4 mg	3 mg	4 mg
24 hrs	4 mg	3 mg	3 mg

Effect of the initial organochlorine pesticide concentration

The adsorption isotherms models of Langmuir and Freundlinch were used for the study [25,26]. The adsorption capacity was determined in beaker containing effluent at 25 ºC and pH 6. A fixed amount of 0.25 g of sorbent was contacted with 50 mL of effluent**(E1)** with different concentrations. The initial concentrations [Co's (mg/L)] of solution were 25, 50, 100, 200and 250 mg/L, respectively. The amounts adsorbed by the resin particles [qe's (mg/g)] were calculated by the mass balance relation:

$$q_e = \frac{(C_o - C_e) \times V}{W}$$

Where Co and Ce are the initial solution concentration (mg/L) and equilibrium concentration (mg/L), respectively; V is the volume of the solution; and W is the weight of the blends(g). The results are taken in triplicate and % removal of organochlorine pesticide from effluent **(E1)** was calculated by using following equation:

$$\text{Adsorption}(\%) = \frac{(C_o - C_e)}{C_o} \text{X } 100$$

The Langmuir isotherm model was applied to these systems to find out the regression coefficient (R20 s) values which were found to be 0.996, 0.993 and 0.995 for B1, B2 and B3, respectively**(Figure-2)**.

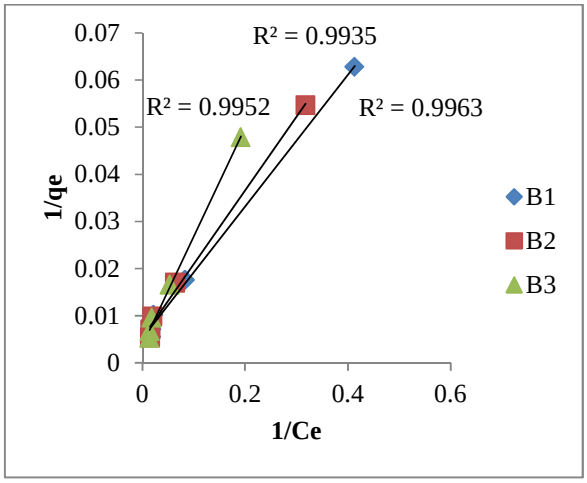

Figure-2Langmuirisotherm

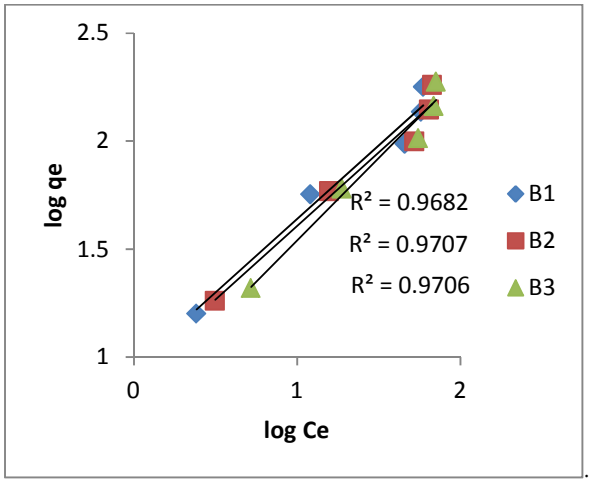

Figure-3 Freundlich isotherm

The logarithmic form of the Freundlich model is given by the following equation:

$$\log q_e = \log K_f + \frac{1}{n}\log C_e$$

Where Kf and n are Freundlich constants related to the adsorption capacity and adsorption intensity, respectively, when log qe was plotted against log Ce, a straight line was obtained with slope 1/n, which showed that the adsorption followed a Freundlich isotherm well. The parameters of the Freundlich isotherm, Kf, which is calculated from the intercept of the plots, and n and R_2, are given in Table 1. R^2values indicate whether the Freundlich isotherm is applicable for a system or not. The R^2 values were 0.968, 0.970, and 0.970 for mixtures B1, B2 and B3, respectively**(Figure-3)**.

CONCLUSION

The absorption study in present work was carried out by Batch equilibrium adsorption experiments at 25^0C and at 6 pH. Results (Table-2) show that the adsorption capacities for organochlorine pesticide were increased with the increase in adsorption time. The results from Langmuir and Freundlich adsorption isotherms are well fitted in the linear forms, while the correlation coefficient values suggest the Langmuir isotherm equation is in good agreement along with highadsorption energy. Amount of natural adsorbent added to the synthesized modified resin not much affected to the correlation coefficient values. So it could be concluded that modified S-MUSPE-resin is active biosorbent for removal of organochlorine pesticides.

REFERENCES

[1].Z. Tang, Q. Huang, Y. Yang, X. Zhu, H. Fu, *Ecotoxicol. Environ.Saf.*,**2013**, 87,89.
[2] H. Liu, Y. Hu, S. Qi, X. Xing, Y. Zhang, D. Yang, C.Qu, *Front. Earth Sci.*,**2015**, 9,248.
[3] W. Zhang, Y. Ye, Y. Tong, L.Ou, D. Hu, X. Wang, *J. Hazard.Mat.*,**2011**, 185, 801.
[4] Z. Singh, J.Kaur, R.Kaur, S. S.Hundal, *Am. J.BioSci.*,**2016**, 4, 11.
[5] G.Kleanthi, L.Katerina, P.Evaggelia, L. Andreas, *Heal. Sci.J.*,**2008**, 2, 89.
[6] M. P. Longnecker, W. J. Rogan, G.Lucier, *Ann. Rev. Publ. Heal.*,**1997**, 18, 211..
[7] J.Dich, S. H.Zahm, A.Hanberg, H. O.Adami, *Canc. Caus. Contr.*,**1997**, 8, 420.
[8] M.Abdollahi, A.Ranjbar, S.Shadnia, S.Nikfar, A.Rezaiee, *Med. Sci.Monit.*,**2004**, 10, 141.
[9] K. E. Noll, V. Gounaris, W. S.Hou; Adsorption Technology for Air and Water Pollution Control, CRC Press, **1991**.
[10] P. T. Thuy, K. Moons, J. C. Van Dijk, N. V. Anh, B. Van der Bruggen, *Water Envir. J.*,**2008**, 22, 217.
[11]. T. P. Baczynski, D. Pleissner, T.Grotenhuis, *Chemosp.*,**2010**, 78, 22.

[12] J. W. Patterson; Industrial wastewater treatment technology, 2nd edition, Butterworth Publishers,Stoneham, MA, USA, **1985**.
[13] W. K. Lafi, Z. Al-Qodah,*J. Hazar. Mat.*,**2006**, 137, 489.
[14] L. W. Canter; Ground water pollution control, Lewis Publishers,Chelsea, MI, USA, **1985**.
[15] J. Senthilnathan, L. Philip, *J.Envir. Sci. Heal.,- B,***2009**, 44, 262.
[16] J. P. Bell, M.Tsezos, *J.Water Poll. Contr.Feder.*,**1987**, 59, 191.
[17] A. Bhatnagar, M. Sillanpaa, *Chem. Engin. J.*,**2010**, 157, 277.
[18] R. C. Bansal, M. Goyal; Activated Carbon Adsorption, CRC press, New York, **2005**.
[19] V. K. Gupta, Suhas,*J.Envir.Manag.*,**2009**, 90, 2313.
[20] G.Crini,*Biores.Techn.*,**2006**, 97, 1061.
[21] A. Gebrekidan, M. Tefari, T. Asmelash, K. Gebrehiwat, A. Hadera, K. Amare, J. Deckers, B. Van der Bruggen, *J. Water Res. Prot.*,**2015**, 7, 278.
[22] P. T.Thuy, N. V. Anh, B. Van der Bruggen, *Clean-Soil, Air, Water.*,**2012**, 40, 246-253 .
[23] H. El Bakouri, J. Morillo, J. Usero, A.Ouassini, *J.Hydrol.*,**2009**, 364, 175.
[24] P. Dave, S. V. Patel, *J. Chem. Pharm. Res.*,**2015**, 7, 168.
[25] N.D. Hutson, R.T. Yang, *Adsor. J. Colloid InterfSci*.,**2000**, 189.
[26] T. H. Vermeulan, K.R. Vermeulan, L.C. Hall.*FundamentalInd. Eng. Chem.*,**1966**, 5, 212.