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Sorption behaviour of lead in selected sewer water irrigated soils

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ABSTRACT

The increasing amounts of lead (Pb) were adsorbed with increasing concentration of Pb in equilibrium solution. At low concentration there was higher adsorption per centage of Pb. The addition of Pb increases its their retention in eight sewer water irrigated soils. Organic matter, clay content and CEC were positively correlated with soil metal retention, whereas, sand had negative correlation. The adsorption data were fitted very well to Freundlich equation and gave highly significant R^2 values. Desorption of adsorbed Pb was achieved more by 0.1N HCl as compared to 0.005 N DTPA and 0.5 N CH_3COOH.

Key words: Lead (Pb), Adsorption, Desorption, Langmuir equation, Freundlich equation

Large areas of Indian soils have received significant amount of lead (Pb) as the agricultural use of pesticides has resulted in the accumulation of Pb in soils. Rural soils can also receive metals in manure, irrigation water, sewage sludge and as atmospheric desorption. Smelting of non ferrous metal ores and coal combustions Pb based paint have resulted in contamination of many agricultural soils with Pb. Accumulation of metals in soils above certain concentration may adversely affect the growth of crops and grazing animals, resulting in increased concentration in plant and animal products and thus pose risk for human health. The most important chemical processes affecting the behaviour and bio availability of metals in soil are these concerned with adsorption of metals from the liquid phase on to solid phase.

MATERIALS AND METHODS

The eight different surface soil samples were collected from long term sewer irrigated fields near the main disposal outlets in Sonipat, Panipat and Hissar districts of Haryana State, India.Important characteristics of initial soils are given in the Table 1.

For adsorption of Pb in eight different soils Pb solution of 0, 5, 10, 20, 50, 100 and 200 mg l^{-1} concentration in 0.002 m $CaCl_2$ solution were prepared with analytical reagent grade salt of lead nitrate. Six sets of 1 g of each soil were taken in centrifuges tubes. Ten ml of each Pb concentration solutions mentioned above were added separately to each set of soil samples.The samples were shaken 4 hours for complete equilibration of Pb with the soil. After equilibration, the samples were centrifuged for 5 minutes at 500 rpm. These equilibrium solutions were analysed for Pb concentration. Adsorption data were fitted to the Freundlich equation as well as Langmuir equation. The Pb adsorbed in the different soil samples was extracted with 0.1 N HCl, 0.5 N CH_3COOH and 0.005 m DTPA for desorption studies.

Table 1: Some important characteristics of soil use in Pb sorption studies.

Sr. No.	Location	* pH	*EC (dSm^{-1})	Mechanical composition (%)			O C (%)	Olsen's P (mg kg^{-1})	$CaCo_3$ (%)	CEC (m.e./100g)	DTPA extractable metals contents (mg kg^{-1})						
				Sand	Silt	Clay					Pb	Cd	Ni	Zn	Fe	Mn	Cu
1	Sonipat	7.80	0.36	59.5	24.6	15.9	1.23	51.2	0.65	10.4	4.90	0.1	2.07	24.0	34.5	11.8	30.1
2	Kabirpur	7.31	0.42	55.7	26.5	17.8	1.35	62.6	0.80	9.8	18.10	0.1	2.5	30.1	39.7	8.7	28.1
3	Sonipat	7.31	0.22	66.4	17.4	16.2	1.29	46.1	0.41	9.7	7.67	0.1	2.1	2.0	5.4	7.3	1.6
4	Panipat	8.25	0.54	68.6	16.7	14.7	0.93	28.7	Tr	8.8	2.31	0.1	0.30	4.2	6.2	11.0	1.9
5	Panipat	8.60	0.28	70.2	15.9	13.9	0.78	24.3	Tr	8.6	2.44	0.1	0.37	2.0	5.4	7.3	1.6
6	Hisar	7.82	0.48	73.1	14.4	12.5	0.64	17.2	Tr	7.6	2.15	0.1	0.35	2.7	4.3	8.7	2.5
7	Hisar	7.67	0.39	76.3	12.3	11.4	0.39	12.0	Tr	7.4	2.78	0.1	0.34	5.3	20.4	5.1	3.4
8	Hisar	6.35	0.04	74.4	12.4	13.2	0.78	22.7	Tr	8.2	2.97	0.3	0.32	16.1	36.4	3.3	4.8

* 1: 2 Soil: Water suspension