ADSORPTION OF TOXIC METAL IONS Pb(II), Cd(II), Hg(II) and Cu (II) ON AGRICULTURAL BYPRODUCTS

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Agricultural by products like religinosa, fucus bengalensis, citrus reticulata, and skin of mangifera Indica, man in kara sapola were used in their natural state on which the study of adsorption of toxic metal ion Pb(II), Cd(II), Cu(II) & Hg (II) at 27^0C has been made. The value of freundlich constant (n & k) are estimated from the study. It can be seen that, adsorption increases with respect to increase in concentration of metal ions.

INTRODUCTION :

The force of attraction existing between molecules in any state of matter shows an inter-molecular attraction or cohesive force of attraction. Adsorption shows the collection of adsorbate on the surface of adsorbent due to cohesive force of attraction. The phenomenon of higher concentration of any molecular species at the surface shows the adsorption. M.C. Bain suggested that absorption and adsorption take place simultaneously.

The presence of toxic metal ions in industrial waste has attracted worldwide attention. Several methods such as chemical precipitation, ion exchange, ultrafiltration, electrochemical treatment etc. are suggested for the removal of these metal ions. Few workers have suggested methods for the adsoprtion of their ions by using inexpensive agricultural byproducts[1-2], tree barks[3-6], peanut skin [7-8] and agircultural waste material[9-11].

We thought of using agricultural byproducts in their natural state. In the present work adsorption of Pb(II),, Cd(II), Cu(II), and Hg (II) on agricultural byproducts such as leaves of Ficus religiosa, Ficus bengalensis, Citrus reticulata and skin of Mangifera indica, Maninkara sapola at 27^0C has been studies.

Adsorption of cadmium and lead from aqueous solution by spent grain have been studied by K.S. Low, C.K. Lee et al[12]. Carolyn A Burns et al[13] had studied the adsorption of aqueous heavy metals onto carbonaceous substrates.

Recently, Agrawal et al[14] and Raghuwanshi et al[15] studied the adsorption of various toxic metal on agricultural byproduct like orange, potato, chickoo and guava.

EXPERIMENTAL:

Leaves of Ficus religiosa, Ficus hengalensis, Citrus reticulata and skin of Mangifera indica, Maninkara sapola were collected, exposed to sunlights for one week. Subsequently they were ground, exposed to sunlight for 24 hours and were preserved in plastic bottles with airtight corks. The solutions of different concentrations (0.01M, 0.008M, 0.006M, 0.004 M, 0.002 M) of Cu(II), Cd(II), Pb(II) and Hg(II) were prepared in different conical flasks, 0.5 gm each of the adsorbent was weighted and placed in each conical flask. The flasks were corked and place overnight. The solution were filtered, pH of filtrates were measured and filtrates were preserved in airtight glass bottles. The change in absorption of metal ions before and after adsorption were measured by spectrophotometer (Table 1 to 5)

The data obtained of % adsorption along with concentration are presented in Table 1 to 5.

RESULTS AND DISCUSSION :

In the present investigation following systems have been studied.

1] Pb(II) - *Ficus religinosa,* Hg(II) - *Ficus religinosa,* Cd(II) - *Ficus religinosa* and Cu (II) - *Ficus religinosa.*

2] Pb(II) - *Ficus bengalensis,* Hg(II) - *Ficus bengalensis,* Cd(II) - *Ficus bengalensis* and Cu (II) - *Ficus bengalensis.*

3] Pb(II) - *Citrus reticulata*, Hg(II) - *Citrus reticulata,* Cd(II) - *Citrus reticulata* and Cu (II) - *Citrus reticulata.*

4] Pb (II) - *Mangifera indica*, Hg(II) - *Mangifera indica,* Cd(II) - *Mangifera indica* and Cu (II) - *Mangifera indica.*

5] Pb (II) - *Maninkara sapola*, Hg(II) - *Maninkara sapola,* Cd(II) - *Maninkara sapola*

and Cu (II) - *Maninkara sapola.*

It could be seen from Tables 1 to 5 that adsorption increase with respect to increase in concentration of metal ions. The orders of adsorption between metal ions and agricultural are shown as under.

1] Cd(II) - *Ficus religinosa* > Hg(II) - *Ficus religinosa* > Cu (II) - *Ficus religinosa*

> Pb (II) - *Ficus religinosa.*

2] Cd(II) - *Ficus bengalensis,* Pb(II) - *Ficus bengalensis,* Hg(II) - *Ficus bengalensis* and

Cu (II) - *Ficus bengalensis.*

3] Cd(II) - *Citrus reticulata* > Pb(II) - *Citrus reticulata* > Hg(II) - *Citrus reticulata* >

Cu (II) - *Citrus reticulata.*

4] Cd(II) - *Mangifera indica* > Cu (II) - *Mangifera indica* > Pb (II) - *Mangifera indica,*

> Hg(II) - *Mangifera indica.*

5] Pb (II) - *Maninkara sapola* > Cd(II) - *Maninkara sapola* > Hg(II) - *Maninkara sapola* > Cu (II) - *Maninkara sapola.*

It could be concluded that Cd(II) acts as a good adsorbate among all the systems except *Maninkara sapola.*

Table - 1

Adsorption of Metal Ions on *Ficus religiosa*.

Conc. mole^{-1} lit^{-1}.	Pb(II)		Hg(II)		Cd(II)		Cu(II)	
	A	logA	A	logA	A	logA	A	logA
0.002	0.544	-0.2644	0.232	-0.6345	0.803	-0.0952	0.250	-0.6989
0.004	0.647	-0.1890	0.463	-0.3344	0.876	-0.0574	0.279	-0.5543
0.006	0.728	-0.1378	0.626	-0.2034	0.904	-0.0438	0.680	-0.1674
0.008	0.796	-0.09908	0.780	-0.1079	0.946	-0.0241	0.855	-0.06803
0.010	0.804	-0.0947	0.926	-0.0333	0.974	-0.0114	0.924	-0.0343

Table - 2

Adsorption of Metal Ions on *Ficus bengalensis*.

Conc. mole^{-1} lit^{-1}.	Pb(II)		Hg(II)		Cd(II)		Cu(II)	
	A	logA	A	logA	A	logA	A	logA
0.002	0.614	-0.2118	0.196	-0.7077	0.887	-0.0520	0.146	-0.8356
0.004	0.707	-0.1505	0.315	-0.5016	0.927	-0.0329	0.177	-0.7520
0.006	0.848	-0.0716	0.374	-0.4271	0.954	-0.02045	0.212	-0.6736
0.008	0.874	-0.05848	0.598	-0.2380	0.967	-0.0145	0.414	-0.3829
0.010	0.936	-0.0287	0.861	-0.0649	0.986	-0.0612	0.551	-0.2588

Table - 3

Adsorption of Metal Ions on *Citrus reticulata*.

Conc. mole^{-1} lit^{-1}.	Pb(II)		Hg(II)		Cd(II)		Cu(II)	
	A	logA	A	logA	A	logA	A	logA
0.002	0.717	-0.1444	0.644	-0.1911	0.796	-0.0990	0.516	-0.2873
0.004	0.745	-0.1278	0.677	-0.1694	0.883	-0.0540	0.548	-0.2612
0.006	0.770	-0.1135	0.709	-0.1493	0.929	-0.0319	0.572	0.2426
0.008	0.849	-0.0710	0.734	-0.1343	0.954	-0.0204	0.638	0.1951
0.010	0.880	-0.0555	0.770	-0.1135	0.975	-0.0109	0.664	0.1178

Table - 4

Adsorption of Metal Ions on *Mangifera indica*.

Conc. mole^{-1} lit^{-1}.	Pb(II)		Hg(II)		Cd(II)		Cu(II)	
	A	logA	A	logA	A	logA	A	logA
0.002	0.196	-0.7077	0.488	-0.3115	0.626	-0.2034	0.425	-0.3716
0.004	0.315	-0.5016	0.543	-0.2628	0.761	-0.1186	0.533	-0.2732
0.006	0.374	-0.4271	0.560	-0.2518	0.836	-0.0777	0.668	-0.1752
0.008	0.578	-0.2380	0.606	-0.2175	0.887	-0.0520	0.728	-0.1378
0.010	0.861	-0.0649	0.803	-0.0952	0.928	-0.0333	0.874	-0.0584

Table - 5

Adsorption of Metal Ions on *Maninkara sapola*.

Conc. mole^{-1} lit^{-1}.	Pb(II)		Hg(II)		Cd(II)		Cu(II)	
	A	logA	A	logA	A	logA	A	logA
0.002	0.122	-0.9136	0.146	-0.8356	0.330	-0.4814	0.129	-0.8894
0.004	0.147	-0.8326	0.176	-0.7544	0.367	-0.4353	0.177	-0.7520
0.006	0.227	-0.6439	0.191	-0.7144	0.383	-0.4168	0.214	-0.6695
0.008	0.333	-0.4775	0.246	-0.6090	0.410	-0.3872	0.252	-0.5985
0.010	0.643	-0.1917	0.300	-0.5228	0.465	-0.3325	0.297	-0.5272

Table - 6

Values of K and n for different systems

Adsorption System	Metal Ion	K	I/n
Ficus religiosa Leaves	Hg(II)	0.9129	0.5000
	Pb(II)	0.8128	0.2307
	Cd(II)	0.9772	0.6666
	Cu(II)	0.9720	0.8636
Ficus bengalensis Leaves	Hg(II)	0.8511	0.6666
	Pb(II)	0.9954	0.2750
	Cd(II)	0.9862	0.0421
	Cu(II)	0.7244	0.9523
Citrus reticulata Skin	Hg(II)	0.7762	0.1250
	Pb(II)	0.8912	0.1400
	Cd(II)	0.9727	0.0466
	Cu(II)	0.6606	0.1470
Mangifera Indica Skin	Hg(II)	0.7994	0.2777
	Pb(II)	0.7585	1.1100
	Cd(II)	0.9120	0.2500
	Cu(II)	0.8709	0.4642
Maninkara sapola Skin	Hg(II)	0.3019	0.4642
	Pb(II)	0.6309	1.0000
	Cd(II)	0.4677	0.2105
	Cu(II)	0.3090	0.4750

LANGMUIR'S ADSORPTION ISOTHERM :

The change in adsorption with respect to concentration at constant temperature deals with the study of Langmuir's adsorption isotherm.

The equation of straight line is presented below.

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log c$$

The formation curves for some representative systems are constructed between log c against log ΔA. Which are found to be straight lines for all the systems.

The values of Freundlich's constants k and n are determined from straight line graphs (i.e. intercept = k, and slope = 1/n) which are presented in Table - 6. These values

(k and n) show good agreement with the concept of Freundlich adsorption.

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