CHAPTER IV

RESULTS

4.1 Chelex-100

4.1.1 Effect of pH on the Recovery Yields of Cd, Cu, Pb and Zn through Chelex-100

The recovery yields of Cd, Cu, Pb and Zn at pH5 to 8 are given in Table 4.1-4.5 and plotted in Fig. 4.1-4.4. A slightly higher yield was observed for all elements at pH7.6. At this pH the precision of the experiment was also observed to be the best.

4.1.2 Effect of Flow Rates on the Recovery of Cd, Cu, Pb and Zn from Sea Water through Chelex-100

The concentration of Cd, Cu, Pb and Zn in 4 dm^3 sea water as determined by varying the flow rate between 1-4 $cm^3/_{min}$ are given in Table 4.6. No significance difference in the concentration was observed when the flow rate was changed although a better precision was observed when the flow rate of 1 $cm^3/_{min}$ was used.

4.1.3 Effect of Nitric Acid Concentration on the Stripping of Cd, Cu, Pb and Zn from Chelex-100

The stripping yield of Cd, Cu, Pb and Zn using nitric acid at various concentration are given in Table 4.7 and plotted in Fig. 4.5-4.8. A complete stripping of Cd, Cu, Pb and Zn could be obtained if the concentration of the nitric acid is higher than 2M. As for Pb a lower acid concentration is also feasible. In the present experiment, 2M nitric acid was normally used as eluting agent.

The elution patterns of Cd, Cu, Pb and Zn with 2M HNO_3 are given in Table 4.8. The elution curves are plotted in Fig. 4.9-4.12. Complete elution of Cd, Cu and Zn was observed by using only 10 cm^3 2M HNO_3.

4.2 Reverse Phase Chromatography

4.2.1 Effect of pH on the Recovery Yield of Cd, Cu, Pb and Zn by Reverse Phase Chromatography

The recovery yields of Cd, Cu, Pb and Zn at pH between 4-7 with APDC as complexing agent, using 60-80 mesh chromosorb W-DMCS, are given in Table 4.9-4.12 and plotted in Fig. 4.13-4.16. Complete recovery of Cu was obtained between pH5-7. A maximum recovery yield of 80% at pH5 was obtained for Cd. The recovery yield of Zn between pH5-7 was practically constant at 80-85%. The recovery yield of Pb was poor all through the pH range applied.

The recovery yields of Cd, Cu, Pb and Zn at pH between 4-7 with APDC as complexing agent, using 100-120 mesh chromosorb W-DMCS, are given in Table 4.13-4.16 and plotted in Fig. 4.17-4.20. Complete recovery of Cu was observed at pH between 4-7. A maximum recovery yield of 88% was obtained for Cd at pH5. The recovery yield of Cd decreases markedly at pH higher than 5. A maximum recovery yield of 90% was obtained for Zn at pH5. The recovery yield of Pb was poor all through the pH range applied.

The recovery yields of Cu at pH between 4-7 with sodium diethyl-dithiocarbamate as complexing agent, using 100-120 mesh chromosorb W-DMCS, are given in Table 4.17 and plotted in Fig. 4.21. Complete recovery of Cu was obtained all through the pH range. The recovery yield of Cd, Pb and Zn was measured and found to be lower than 20% and hence were not reported.

4.2.2 Effect of Particle Size of the Solid Support on the Recovery Yield of Cd, Cu, Pb and Zn by Reverse Phase Chromatography

The recovery yields of Cd, Cu, Pb and Zn through chromosorb W-DMCS with particle sizes 60-80, 80-100 and 100-120 mesh are given in Table 4.10, 4.14 and 4.18 and plotted in Fig. 4.22-4.25. No significant difference was observed in all cases.

4.2.3 Effect of Flow Rates on the Recovery Yield of Cd, Cu, Pb and Zn by Reverse Phase Chromatography

The recovery yield of Cd, Cu, Pb and Zn are determined by varying the flow rate between 2-8 $cm^3/_{min}$ are given in Table 4.10, 4.19-4.21 and plotted in Fig. 4.26-4.29. A slightly decrease in the recovery yield of Cd was observed when the rate is higher than 4 $cm^3/_{min}$. The recovery yield of Cu is constant at flow rate between 2-6 $cm^3/_{min}$. The recovery yield of Cu decreases 20% when the flow rate is higher than 6 $cm^3/_{min}$. No significant difference in the recovery yield was observed for Pb and Zn when the flow rate was changed although a better precision was observed when the flow rate is lower than 4 $cm^3/_{min}$.

4.2.4 Effect of Eluting Agents on the Recovery Yield of Cd, Cu, Pb and Zn by Reverse Phase Chromatography

The recovery yield of Cd, Cu, Pb and Zn using chloroform, benzene and toluene as eluting agents are given in Table 4.10, 4.22 and 4.23 and plotted in Fig. 4.30-4.33. Complete recovery of Cu was observed when chloroform was used as eluting agent. No significant difference was observed in the cases of Cd and Zn for which the recovery yield was about 80 %. The recovery yield of Pb was low in all cases.

4.2.5 Effect of Acid Concentration on the Stripping of Cd, Cu, Pb and Zn from Chloroform

The stripping of Cd, Cu, Pb and Zn by hydrochloric acid at various concentration are given in Table 4.24 and plotted in Fig. 4.34-4.37. Complete stripping of Cd, Pb and Zn could be obtained if the concentration of HCl is higher than 2M, 4M and 0.5M respectively. Cu could not be stripped quantitatively with HCl. The stripping of Cd, Cu, Pb and Zn using nitric acid at various concentration are given in Table 4.25 and plotted in Fig. 4.38-4.41. Complete stripping of

Cd, Cu, Pb and Zn could be obtained if the concentration of HNO_3 is higher than 1M, 6M, 5M and 1M respectively. 6M HNO_3 was normally used as stripping agent.

The results of the analysis of five samples of sea water after preconcentration by chelex-100 are given in Table 4.26. Table 4.27 gives the results by reverse phase chromatography prior to and after correction of chemical yield. Table 4.28 gives the results of both procedures in comparision to each other. It is obvious that the results from both procedures agree very well with each other.

Table 4.1 The recovery yield of Cd, Cu, Pb and Zn at pH5.0.

No of Experiment	Cu			Cd			Zn			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	4	3.38	84.62	2	0.55	27.33	30	25.79	85.95	10	8.87	88.67
2	4	3.43	85.67	2	0.48	24.00	30	26.35	87.83	10	8.87	88.67
3	4	3.73	93.33	2	0.99	49.33	30	27.90	93.00	10	8.76	87.60
4	4	3.73	93.33	2	1.06	53.20	30	25.92	86.40	10	8.54	85.40
5	4	3.60	90.00	2	0.62	30.93	30	27.49	91.63	10	8.66	86.60
6	4	3.69	92.30	2	0.56	28.00	30	28.31	94.36	10	8.66	86.60
7	4	3.43	85.67	2	0.64	31.87	30	28.55	95.18	10	9.08	90.80
8	4	3.54	88.60	2	0.56	27.75	30	28.02	94.40	10	9.28	92.80
9	4	3.90	97.60	2	0.51	25.60	30	26.78	89.28	10	9.28	92.80
10	4	3.84	96.00	2	0.48	24.00	30	27.28	90.93	10	8.85	88.50
$\overline{X}$			90.68			32.30			90.80			88.84
SD			4.518			10.411			3.303			2.556
RSD			4.928			32.332			3.637			2.877

Table 4.2 The recovery yield of Cd, Cu, Pb and Zn at pH6.0.

No of Experiment	Cu			Cd			Zn			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	4	3.37	84.20	2	1.64	82.20	30	26.99	89.96	10	8.60	86.00
2	4	3.68	92.00	2	1.68	84.00	30	27.45	91.50	10	8.45	84.50
3	4	3.57	89.33	2	1.68	84.00	30	28.83	96.10	10	8.57	85.67
4	4	3.75	93.70	2	1.68	84.00	30	28.56	95.20	10	8.57	85.67
5	4	3.70	92.50	2	1.83	91.47	30	26.39	87.95	10	8.64	86.40
6	4	3.89	97.17	2	1.83	91.47	30	28.38	94.60	10	8.64	86.40
7	4	3.67	91.67	2	1.70	84.93	30	25.91	86.38	10	9.25	92.50
8	4	3.55	88.67	2	1.75	87.33	30	25.92	86.40	10	8.80	88.80
9	4	3.51	87.67	2	1.70	85.06	30	25.98	86.60	10	9.80	98.80
10	4	3.84	96.00	2	1.75	87.47	30	27.18	90.59	10	8.80	88.00
$\overline{X}$			91.29			86.19			90.53			88.27
SD			3.927			3.195			3.757			4.333
RSD			4.301			3.707			4.150			4.909

Table 4.3 The recovery yield of Cd, Cu, Pb and Zn at pH7.0 .

No of Experiment	Cu			Cd			Zn			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	4	3.74	93.40	2	1.78	88.97	30	28.84	96.14	10	8.40	84.00
2	4	3.74	93.40	2	1.78	88.93	30	28.34	94.45	10	9.57	95.67
3	4	3.56	89.00	2	1.84	92.13	30	28.82	96.05	10	9.33	93.33
4	4	3.56	89.00	2	1.81	90.53	30	28.08	93.61	10	10.00	100.00
5	4	3.75	93.67	2	1.81	90.53	30	28.50	95.00	10	8.64	86.40
6	4	3.57	89.33	2	1.81	90.53	30	28.05	93.50	10	8.48	84.82
7	4	3.43	85.67	2	1.83	91.33	30	28.98	96.60	10	9.20	92.00
8	4	3.56	89.00	2	1.81	90.70	30	29.16	97.20	10	10.00	100.00
9	4	3.56	89.00	2	1.80	89.87	30	27.83	92.78	10	9.40	94.00
10	4	3.64	91.00	2	1.83	91.33	30	30.87	102.92	10	8.48	84.80
$\bar{X}$			90.24			90.49			95.83			91.64
SD			2.572			1.015			2.889			6.482
RSD			2.851			1.122			3.317			7.073

Table 4.4 The recovery yield of Cd, Cu, Pb and Zn at pH7.6 .

No of Experiment	Cu			Cd			Zn			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	4	3.87	96.80	2	1.86	93.00	30	29.34	97.80	10	9.40	94.00
2	4	3.97	99.20	2	1.88	93.80	30	30.29	100.97	10	9.80	98.00
3	4	3.97	99.20	2	1.88	93.80	30	27.89	92.97	10	9.60	96.00
4	4	3.95	98.80	2	1.90	95.12	30	29.19	97.30	10	9.40	94.00
5	4	3.95	98.80	2	1.91	95.68	30	28.65	95.50	10	10.00	100.00
6	4	3.98	99.60	2	1.93	96.60	30	28.39	94.63	10	10.24	102.40
7	4	3.98	99.60	2	1.93	96.70	30	28.70	95.68	10	10.00	100.00
8	4	3.92	98.00	2	1.88	94.13	30	29.33	97.78	10	10.10	101.00
9	4	4.00	100.00	2	1.88	94.13	30	29.20	97.32	10	10.00	100.00
10	4	4.00	100.00	2	1.94	96.93	30	28.92	96.40	10	10.00	100.00
$\overline{X}$			99.00			94.99			96.63			98.04
SD			0.984			1.416			2.147			2.893
RSD			0.994			1.491			2.222			2.951

Table 4.5 The recovery yield of Cd, Cu, Pb and Zn at pH8.0.

No of Experiment	Cu			Cd			Zn			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	4	3.49	87.33	2	1.85	92.33	30	25.47	84.90	10	8.73	87.33
2	4	3.66	91.39	2	1.80	90.00	30	25.16	83.88	10	7.97	79.76
3	4	3.57	89.23	2	1.81	90.27	30	24.09	80.30	10	9.16	91.60
4	4	3.49	87.33	2	1.72	86.00	30	27.81	92.70	10	9.16	91.60
5	4	3.67	91.67	2	1.72	86.00	30	26.07	86.91	10	8.14	81.40
6	4	3.65	91.33	2	1.81	90.27	30	27.21	90.69	10	8.14	81.40
7	4	3.57	89.33	2	1.84	92.13	30	27.11	90.35	10	8.64	86.40
8	4	3.56	89.00	2	1.79	89.60	30	26.61	88.70	10	8.24	82.40
9	4	3.73	93.33	2	1.84	91.87	30	26.89	89.63	10	8.74	87.40
10	4	3.65	91.33	2	1.75	87.33	30	27.71	92.35	10	8.24	82.40
$\overline{X}$			90.13			89.58			88.05			85.18
SD			1.986			2.384			4.011			4.326
RSD			2.303			2.661			4.556			5.079

Fig. 4.1-4.4 Effect of pH on the recovery yield of Cd, Cu, Pb and Zn through chelex-100

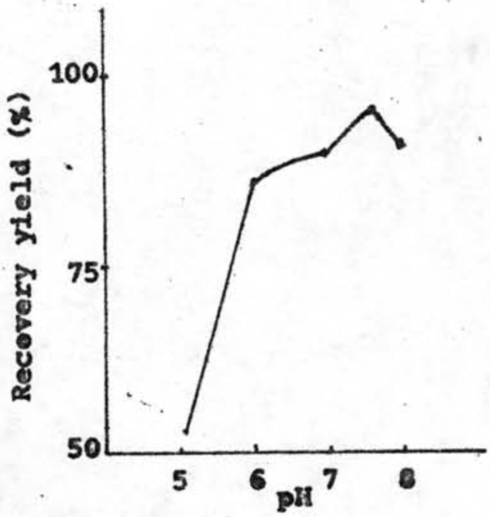


Fig. 4.1 : Cd

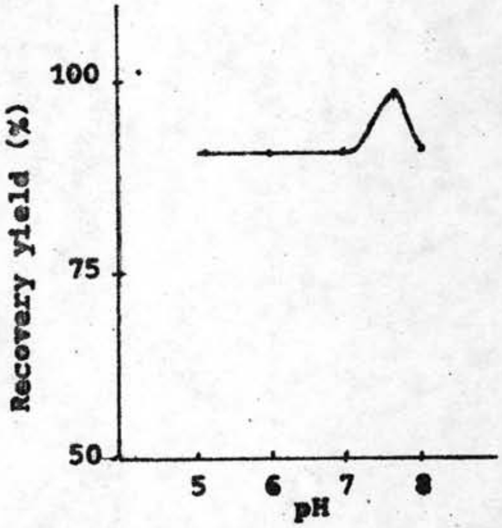


Fig. 4.2 : Cu

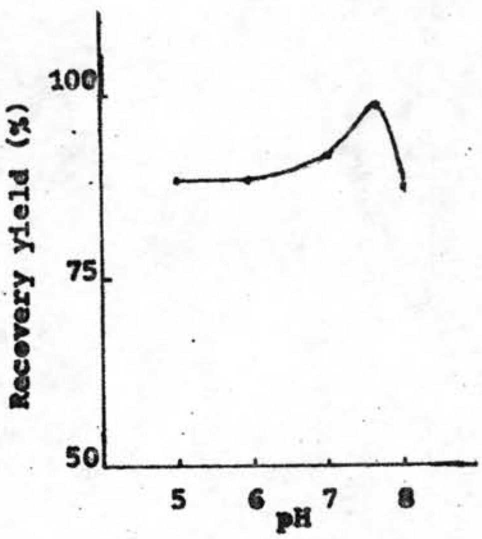


Fig. 4.3 : Pb

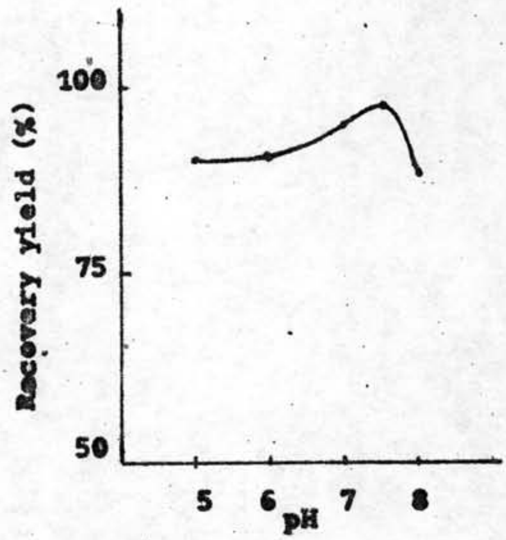


Fig. 4.4 : Zn

Table 4.6 The recovery of Cd, Cu, Pb and Zn from 4 dm^3 sea water.

No of Experiment	Cu(ppb)				Cd(ppb)				Zn(ppb)				Pb(ppb)			
	Flow rate 1.0 cm^3/min	Flow rate 2.0 cm^3/min	Flow rate 3.0 cm^3/min	Flow rate 4.0 cm^3/min	Flow rate 1.0 cm^3/min	Flow rate 2.0 cm^3/min	Flow rate 3.0 cm^3/min	Flow rate 4.0 cm^3/min	Flow rate 1.0 cm^3/min	Flow rate 2.0 cm^3/min	Flow rate 3.0 cm^3/min	Flow rate 4.0 cm^3/min	Flow rate 1.0 cm^3/min	Flow rate 2.0 cm^3/min	Flow rate 3.0 cm^3/min	Flow rate 4.0 cm^3/min
1	2.60	2.58	2.60	2.65	0.104	0.099	0.106	0.095	20.36	20.65	20.62	21.20	0.42	0.38	0.45	0.44
2	2.60	2.60	2.64	2.58	0.102	0.105	0.098	0.106	20.48	20.50	21.00	20.45	0.45	0.46	0.48	0.49
3	2.58	2.62	2.54	2.72	0.100	0.102	0.098	0.108	20.52	20.42	20.24	20.75	0.45	0.45	0.37	0.37
4	2.56	2.54	2.70	2.49	0.098	0.104	0.104	0.097	20.64	20.28	20.72	21.28	0.40	0.45	0.45	0.37
$\bar{X}$	2.59	2.59	2.62	2.61	0.101	0.102	0.102	0.102	20.50	20.46	20.65	20.67	0.430	0.435	0.418	0.418
SD	0.019	0.034	0.067	0.098	0.002	0.003	0.004	0.006	0.115	0.155	0.314	0.403	0.024	0.037	0.056	0.058
RSD	0.741	1.322	2.569	3.771	2.556	2.593	3.786	6.378	0.563	0.758	1.521	1.951	5.696	8.498	13.438	14.001

Table 4.7 Nitric acid concentration on the stripping of Cd, Cu, Pb and Zn from chelex-100 .

No of Experiment	Recovery yield of Cu(%)				Recovery yield of Cd(%)				Recovery yield of Zn(%)				Recovery yield of Pb(%)			
	HNO_3 1M	HNO_3 2M	HNO_3 3M	HNO_3 4M	HNO_3 1M	HNO_3 2M	HNO_3 3M	HNO_3 4M	HNO_3 1M	HNO_3 2M	HNO_3 3M	HNO_3 4M	HNO_3 1M	HNO_3 2M	HNO_3 3M	HNO_3 4M
1	92.33	100.00	98.00	100.00	92.40	94.83	95.25	95.40	96.33	95.68	95.25	94.52	100.00	100.00	99.40	99.40
2	92.33	100.00	100.00	100.00	92.40	94.83	94.20	94.53	95.45	97.78	95.25	97.06	100.00	100.00	99.40	99.40
3	92.33	99.80	100.00	100.00	94.13	95.63	96.23	94.53	94.85	97.32	96.25	96.96	100.00	100.00	99.40	98.40
4	89.66	98.80	98.27	98.40	92.40	96.00	95.25	93.60	93.80	96.40	97.50	96.84	98.50	99.50	98.00	98.00
$\overline{X}$	91.66	99.65	99.06	99.60	92.83	95.32	95.22	94.52	95.11	96.80	96.06	96.35	99.63	99.88	99.05	98.70
SD	1.335	0.574	1.082	0.800	0.865	0.588	0.830	0.735	1.063	0.939	1.068	1.220	0.750	0.250	0.700	0.808
RSD	1.456	0.576	1.093	0.803	0.932	0.617	0.871	0.778	1.111	0.970	1.112	1.226	0.753	0.251	0.707	0.819

Fig. 4.5-4.8 Effect of nitric acid concentration on the stripping of Cd, Cu, Pb and Zn from chelex-100

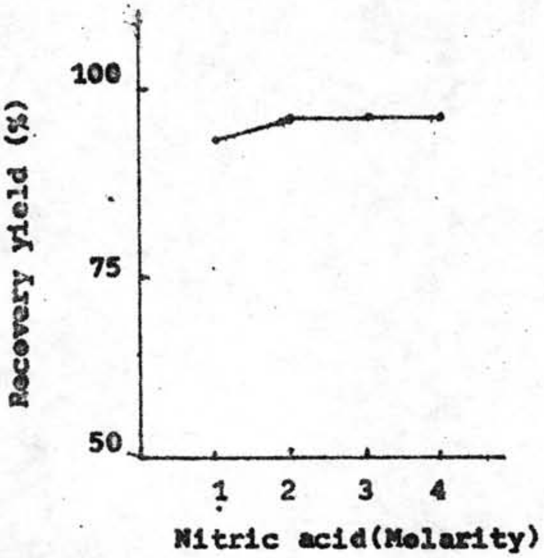


Fig. 4.5 : Cd

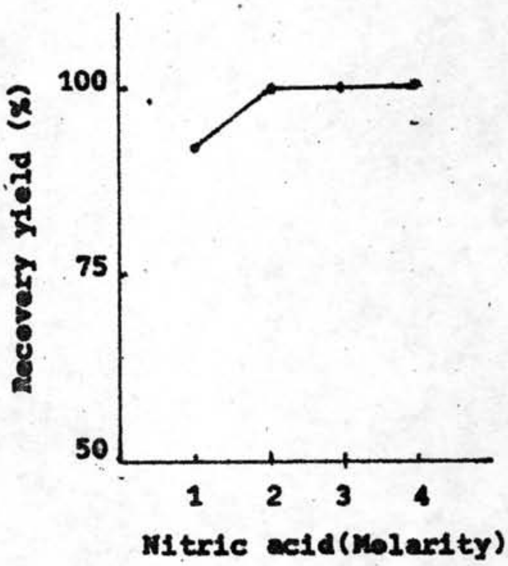


Fig. 4.6 : Cu

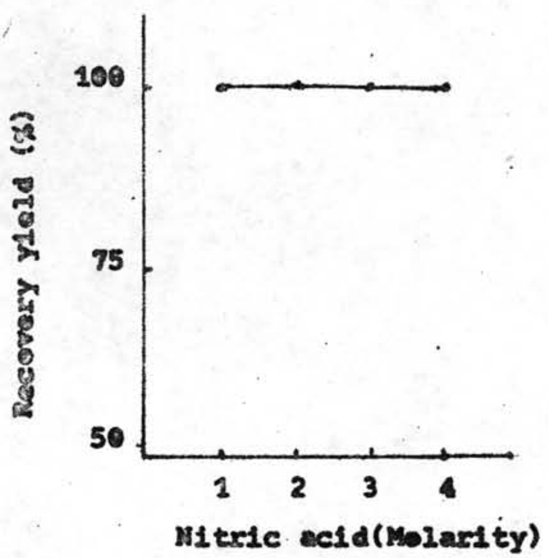


Fig. 4.7 : Pb

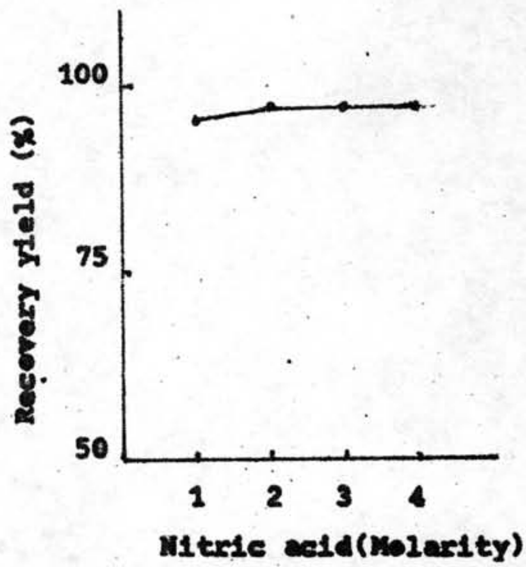


Fig. 4.8 : Zn

Table 4.8 Elution patterns of Cd, Cu, Pb and Zn
Eluting agent : 2M HNO_3
Flow rate : 1 $cm^3/_{min}$

Fraction	Elution of Cu(%)			Elution of Cd(%)			Elution of Zn(%)			Elution of Pb(%)		
No	No1	No2	No3	No1	No2	No3	No1	No2	No3	No1	No2	No3
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	1.33	1.33	1.33	-	-	-
3	1.85	3.50	1.85	1.51	1.38	1.82	4.33	3.56	3.74	13.40	12.28	10.35
4	15.15	16.18	17.10	17.50	18.14	18.62	7.52	8.17	8.30	70.15	68.25	75.60
5	43.50	44.20	45.08	40.00	38.26	41.20	15.17	16.08	15.21	16.35	17.40	13.25
6	22.40	21.38	19.48	27.52	26.44	24.45	33.52	35.12	35.00	-	-	-
7	10.30	10.10	9.50	7.50	7.92	7.30	17.50	18.12	17.18	-	-	-
8	3.25	1.75	4.00	-	-	-	9.48	10.30	10.14	-	-	-
9	-	-	-	-	-	-	4.98	4.52	3.88	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-

Note - : un detectable

Fig. 4.9-4.12 Elution patterns of Cd, Cu, Pb and Zn with $2M\ HNO_3$

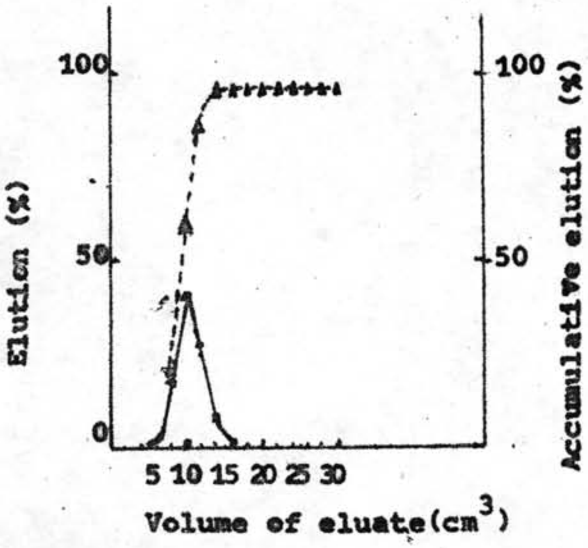


Fig. 4.9 : Cd

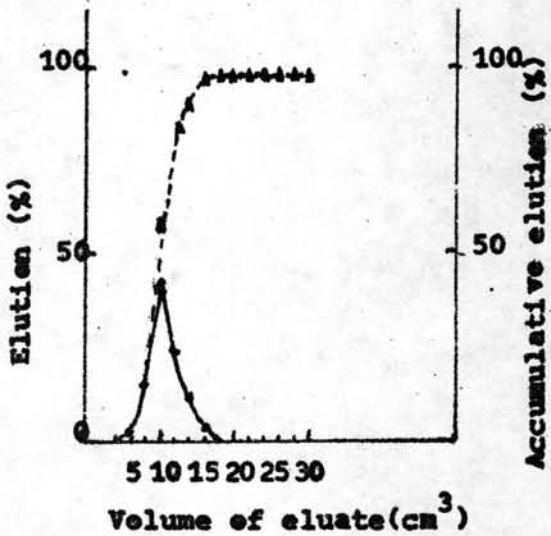


Fig. 4.10 : Cu

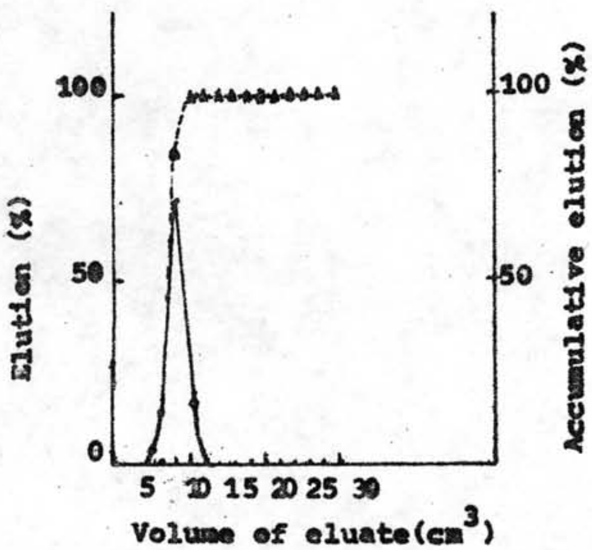


Fig. 4.11 : Pb

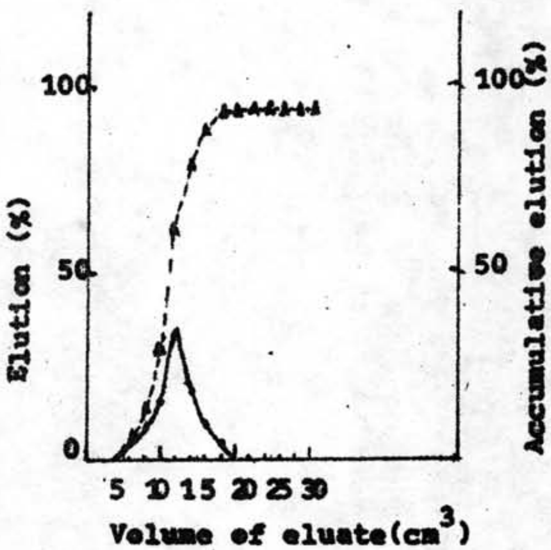


Fig. 4.12 : Zn

Table 4.9 The recovery yield of Cd, Cu, Pb and Zn at pH4.0.

Condition:

Chromosorb W-DMCS 60-80 mesh   Complexing agent : APDC

No of Experi-ment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	6.50	65.00	2	1.18	59.00	4	3.76	94.00	10	4.00	40.00
2	10	7.20	72.00	2	1.11	55.70	4	3.60	90.00	10	4.20	42.00
3	10	6.45	64.50	2	1.14	57.00	4	3.68	92.00	10	4.00	40.00
4	10	7.42	74.20	2	1.21	60.50	4	3.83	95.80	10	4.50	45.00
5	10	6.60	66.00	2	1.29	64.50	4	3.74	93.60	10	4.[illegible]	40.00
6	10	6.75	67.50	2	1.27	63.60	4	3.74	93.40	10	4.50	45.00
7	10	7.06	70.60	2	1.31	65.30	4	3.80	95.00	10	4.00	40.00
8	10	6.65	66.50	2	1.26	62.80	4	3.82	95.50	10	4.00	40.00
$\overline{X}$			68.29			61.05			93.76			41.50
SD			3.551			3.567			1.724			2.330
RSD			5.201			5.843			1.838			5.614

Table 4.10 The recovery yield of Cd, Cu, Pb and Zn at pH5.0

Condition:

Chromosorb W-DMCS 60-80 mesh Complexing agent : APDC

No of Experiment	Zn			Cd			Cu			Pb		
	μg added	μg found	% Recovery	μg added	μg found	% Recovery	μg added	μg found	% Recovery	μg added	μg found	% Recovery
1	10	8.80	88.00	2	1.60	78.00	4	4.00	100.00	10	5.80	58.00
2	10	8.65	86.50	2	1.67	83.60	4	4.00	100.00	10	5.80	58.00
3	10	8.95	89.50	2	1.67	83.60	4	3.96	99.00	10	5.35	53.50
4	10	9.10	91.00	2	1.57	78.30	4	4.00	100.00	10	5.35	53.50
5	10	9.14	91.40	2	1.68	84.00	4	3.98	99.50	10	5.50	55.00
6	10	8.93	89.30	2	1.71	85.50	4	4.00	100.00	10	5.50	55.00
7	10	8.93	89.30	2	1.60	80.00	4	3.94	98.50	10	5.50	55.00
8	10	8.51	85.08	2	1.63	81.60	4	4.00	100.00	10	5.80	58.00
$\overline{X}$			88.76			82.03			99.63			55.56
SD			2.150			2.492			0.582			2.112
RSD			2.422			3.037			0.585			3.801

Table 4.11 The recovery yield of Cd, Cu, Pb and Zn at pH6.0 .

Condition:

Chromosorb W-DMCS 60-80 mesh Complexing agent : APDC

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	8.40	84.00	2	1.15	57.40	4	4.00	100.00	10	5.50	55.50
2	10	8.85	88.50	2	1.21	60.60	4	4.00	100.00	10	5.50	55.50
3	10	8.75	87.50	2	1.25	62.60	4	4.00	100.00	10	6.00	60.00
4	10	8.90	89.00	2	1.12	60.50	4	4.00	100.00	10	6.00	60.00
5	10	8.32	83.20	2	1.16	58.00	4	3.80	95.00	10	6.00	60.00
6	10	8.65	86.50	2	1.17	58.50	4	3.92	98.00	10	5.80	58.00
7	10	8.80	88.00	2	1.30	64.80	4	3.91	97.80	10	5.80	58.00
8	10	8.28	82.80	2	1.26	63.20	4	3.94	98.50	10	5.80	58.00
$\overline{X}$			86.19			60.70			98.66			57.81
SD			2.494			2.666			1.764			2.086
RSD			2.894			4.392			1.788			3.609

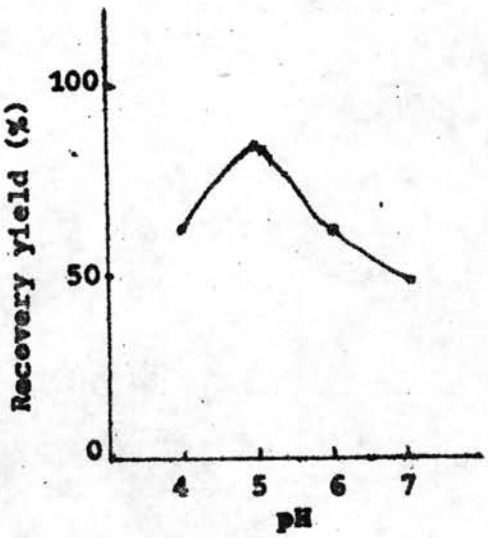
Table 4.12 The recovery yield of Cd, Cu, Pb and Zn at pH7.0 .

Condition:

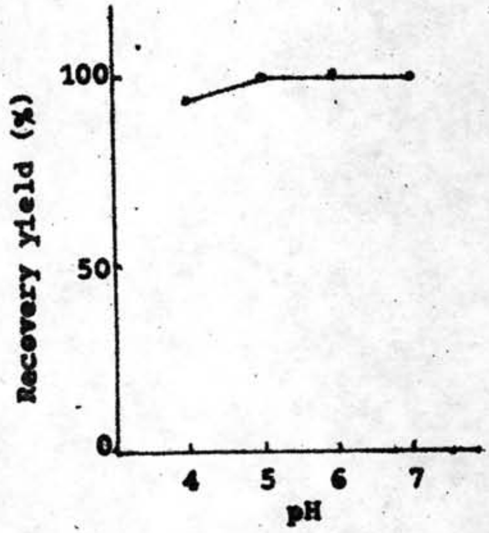
Chromosorb W-DMCS 60-80 mesh Complexing agent : APDC

No of Experi-ment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	7.80	78.00	2	1.01	50.30	4	3.98	99.50	10	5.80	58.00
2	10	7.82	78.20	2	1.03	51.50	4	4.00	100.00	10	5.50	55.00
3	10	8.18	81.80	2	0.91	45.70	4	3.93	98.25	10	6.00	60.00
4	10	7.75	77.50	2	0.94	46.80	4	3.87	96.80	10	6.00	60.00
5	10	7.72	77.20	2	0.99	49.60	4	3.92	98.00	10	5.80	58.00
6	10	7.84	78.40	2	0.96	48.00	4	4.00	100.00	10	5.50	55.00
7	10	8.16	81.60	2	0.95	47.50	4	3.90	97.50	10	5.50	55.00
8	10	8.37	83.70	2	0.91	45.60	4	3.89	97.25	10	5.80	58.00
$\bar{X}$			79.55			48.12			98.41			57.38
SD			2.442			2.162			1.265			2.134
RSD			3.070			4.492			1.286			3.719

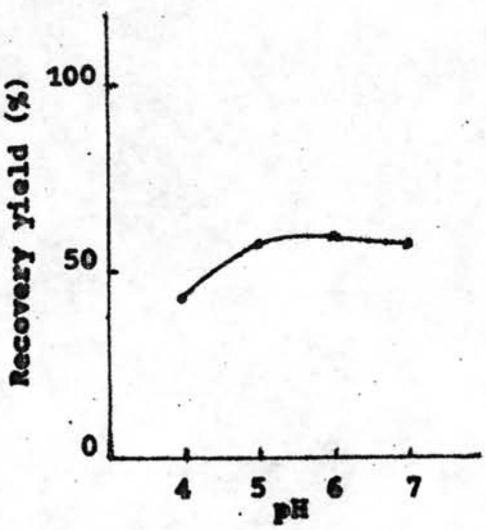
<u>Fig. 4.13-4.16</u> Effect of pH on the recovery yield of Cd, Cu, Pb and Zn by reverse phase chromatography. : chromosorb W-DMCS 60-80 mesh.



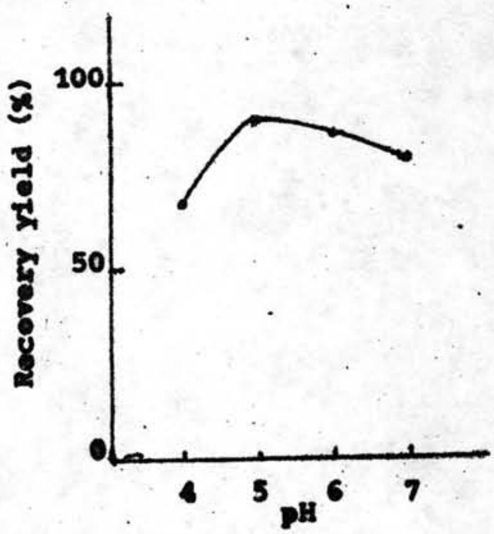
<u>Fig. 4.13</u> : Cd



<u>Fig. 4.14</u> : Cu



<u>Fig. 4.15</u> : Pb



<u>Fig. 4.16</u> : Zn

Table 4.13 The recovery yield of Cd, Cu, Pb and Zn at pH4.0.

Condition:

Chromosorb W-DMCS 100-120 mesh Complexing agent : APDC

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	7.85	78.50	2	1.52	75.80	4	3.84	96.00	10	5.00	50.00
2	10	8.04	80.40	2	1.51	75.40	4	3.84	96.00	10	5.50	55.00
3	10	7.36	73.60	2	1.59	79.50	4	3.94	98.50	10	5.00	50.00
4	10	7.44	74.43	2	1.41	70.50	4	3.94	98.50	10	4.85	48.50
5	10	7.05	70.54	2	1.62	81.00	4	4.00	100.00	10	5.00	50.00
6	10	7.25	72.50	2	1.54	76.80	4	4.00	100.00	10	4.85	48.50
7	10	7.52	75.20	2	1.51	75.40	4	3.96	99.00	10	4.85	48.50
8	10	7.75	77.45	2	1.58	78.80	4	3.94	98.50	10	4.85	48.50
$\overline{X}$			75.33			76.65			98.30			49.88
SD			3.274			3.237			1.557			2.200
RSD			4.346			4.223			1.584			4.410

Table 4.14 The recovery yield of Cd, Cu, Pb and Zn at pH5.0 .

Condition:

Chromosorb W-DMCS 100-120 mesh Complexing agent : APDC

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	8.63	86.30	2	1.82	91.00	4	4.00	100.00	10	5.50	55.00
2	10	9.29	92.90	2	1.78	89.20	4	4.00	100.00	10	5.50	55.00
3	10	8.83	88.30	2	1.76	88.20	4	3.95	98.75	10	5.30	53.00
4	10	9.41	94.10	2	1.76	87.80	4	4.00	100.00	10	5.30	53.00
5	10	8.85	88.50	2	1.71	85.40	4	3.96	99.00	10	5.50	55.00
6	10	8.67	86.70	2	1.80	90.00	4	4.00	100.00	10	5.80	58.00
7	10	9.00	90.00	2	1.71	85.40	4	3.94	98.50	10	5.80	58.00
8	10	8.95	89.50	2	1.77	88.50	4	4.00	100.00	10	5.80	58.00
$\bar{X}$			89.54			88.19			99.53			55.63
SD			2.764			2.000			0.661			2.134
RSD			3.087			2.268			0.664			3.836

Table 4.15 The recovery yield of Cd, Cu, Pb and Zn at pH6.0 .

Condition:

Chromosorb W-DMCS 100-120 mesh Complexing agent : APDC

No of Experi-ment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	8.54	85.40	2	1.19	59.50	4	4.00	100.00	10	6.85	68.50
2	10	8.50	85.00	2	1.15	57.50	4	3.92	98.00	10	6.85	68.50
3	10	8.12	81.20	2	1.25	62.50	4	4.00	100.00	10	6.85	68.50
4	10	8.34	83.40	2	1.28	64.00	4	4.00	100.00	10	6.50	65.00
5	10	8.76	87.60	2	1.18	59.00	4	3.92	98.00	10	6.50	65.00
6	10	8.36	83.60	2	1.17	58.80	4	3.92	98.00	10	6.50	65.00
7	10	8.70	87.00	2	1.26	63.00	4	4.00	100.00	10	6.35	63.50
8	10	9.02	90.20	2	1.27	63.50	4	3.85	96.25	10	6.35	63.50
$\bar{X}$			85.45			60.98			98.78			65.94
SD			2.812			2.531			1.423			2.211
RSD			3.290			4.150			1.441			3.353

Table 4.16 The recovery yield of Cd, Cu, Pb and Zn at pH7.0.

Condition:

Chromosorb W-DMCS 100-120 mesh   Complexing agent : APDC

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	7.82	78.20	2	0.97	48.50	4	3.94	98.50	10	6.55	65.50
2	10	8.38	83.80	2	0.84	42.00	4	3.94	98.50	10	6.55	65.50
3	10	7.62	76.20	2	0.83	41.50	4	4.00	100.00	10	6.00	60.00
4	10	8.25	82.50	2	1.00	50.00	4	3.96	99.00	10	6.00	60.00
5	10	8.42	84.20	2	0.92	45.80	4	3.92	98.00	10	6.00	60.00
6	10	7.83	78.30	2	1.01	50.50	4	3.90	97.50	10	6.55	65.50
7	10	8.05	80.50	2	0.94	46.80	4	3.94	98.50	10	6.00	60.00
8	10	7.98	79.80	2	0.87	43.25	4	3.82	95.50	10	6.00	60.00
$\overline{X}$			80.44			46.04			98.19			62.75
SD			2.870			3.525			1.308			2.940
RSD			3.568			7.650			1.332			4.685

Fig. 4.17-4.20 Effect of pH on the recovery yield of Cd, Cu, Pb and Zn by reverse phase chromatography. : chromosorb W-DMCS 100-120 mesh.

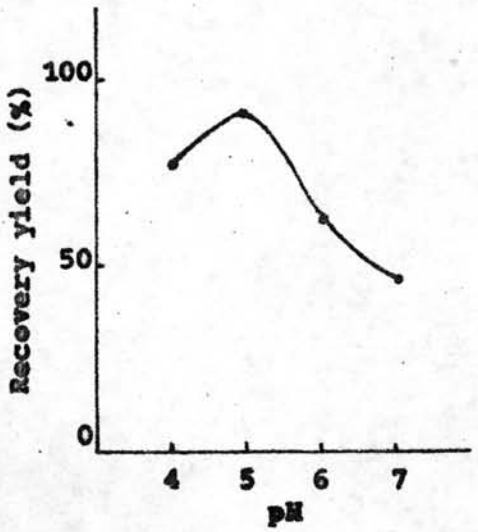


Fig. 4.17 : Cd

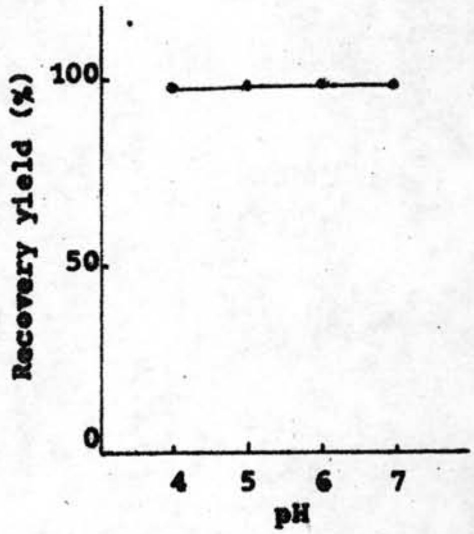


Fig. 4.18 : Cu

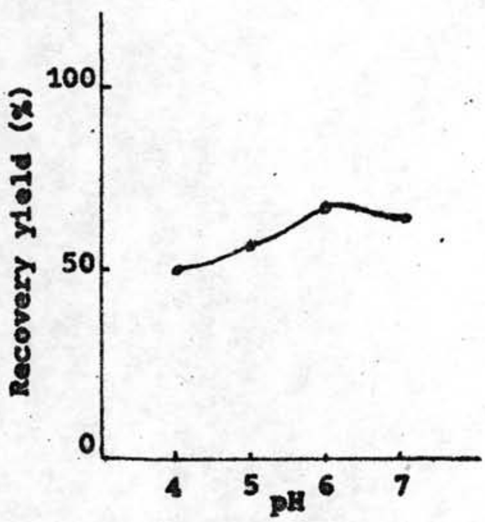


Fig. 4.19 : Pb

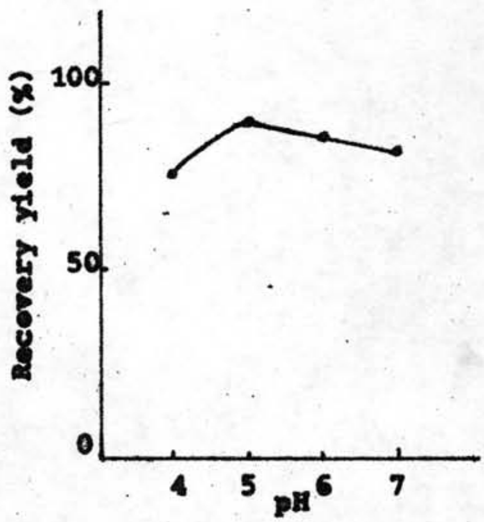


Fig. 4.20 : Zn

Table 4.17 The recovery yield of Cu at pH between 4-7.

Condition:

Chromosorb W-DMCS 100-120 mesh   Complexing agent : NaDEDTC

No of Experiment	Cu at pH4			Cu at pH5			Cu at pH6			Cu at pH7		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	4	4.00	100.00	4	4.00	100.00	4	4.00	100.00	4	3.90	97.50
2	4	4.00	100.00	4	4.00	100.00	4	3.94	98.50	4	3.94	98.50
3	4	3.88	97.00	4	3.94	98.50	4	3.94	98.50	4	4.00	100.00
4	4	3.90	97.50	4	4.00	100.00	4	4.00	100.00	4	3.94	98.50
5	4	3.92	98.00	4	3.94	98.50	4	4.00	100.00	4	3.92	98.00
6	4	4.00	100.00	4	4.00	100.00	4	4.00	100.00	4	3.90	97.50
7	4	4.00	100.00	4	4.00	100.00	4	3.94	98.50	4	3.96	99.00
8	4	3.94	98.50	4	4.00	100.00	4	4.00	100.00	4	3.92	98.00
$\overline{X}$			98.87			99.63			99.14			98.38
SD			1.275			0.694			0.776			0.835
RSD			1.289			0.697			0.781			0.848

Fig. 4.21 Effect of pH on the recovery yield of Cu by reverse phase chromatography.

: chromosorb W-DMCS 100-120 mesh

: sodium diethyl-dithiocarbamate

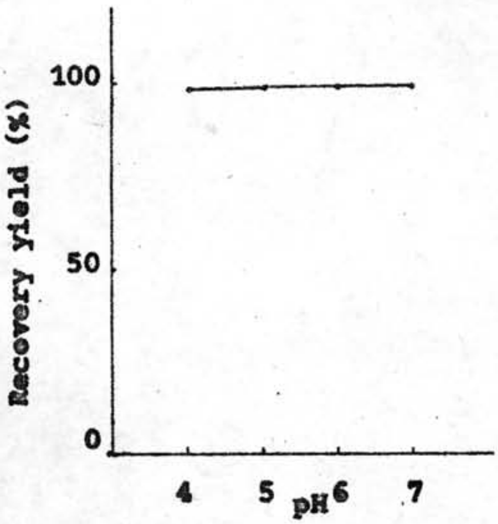


Fig. 4.21 : Cu

Table 4.18 The recovery yield of Cd, Cu, Pb and Zn at pH5.0.

Condition:

Chromosorb W-DMCS 80-100 mesh   Complexing agent : APDC

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	9.24	92.40	2	1.65	82.50	4	4.00	100.00	10	5.50	55.00
2	10	8.75	87.50	2	1.70	85.00	4	4.00	100.00	10	5.75	57.50
3	10	9.00	90.00	2	1.72	86.00	4	4.00	100.00	10	5.75	57.50
4	10	8.90	89.00	2	1.69	84.50	4	4.00	100.00	10	5.75	57.50
5	10	9.10	91.00	2	1.67	83.50	4	4.00	100.00	10	5.25	52.50
6	10	8.64	86.45	2	1.68	84.20	4	3.92	98.00	10	5.50	55.00
7	10	8.55	85.50	2	1.59	79.50	4	3.94	98.50	10	5.25	52.50
8	10	9.00	90.00	2	1.72	86.20	4	4.00	100.00	10	5.25	52.50
$\bar{X}$			88.98			83.93			99.56			55.00
SD			2.347			2.166			0.821			2.315
RSD			2.638			2.580			0.825			4.208

Fig. 4.22-4.25 Effect of particle size of the solid support on the recovery yield of Cd, Cu, Pb and Zn by reverse phase chromatography.

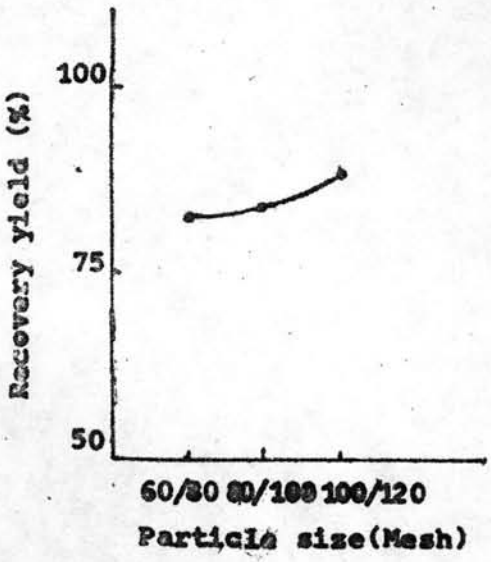


Fig. 4.22 : Cd

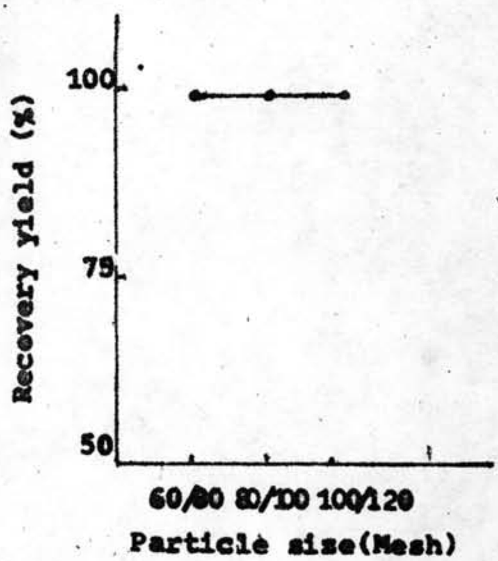


Fig. 4.23 : Cu

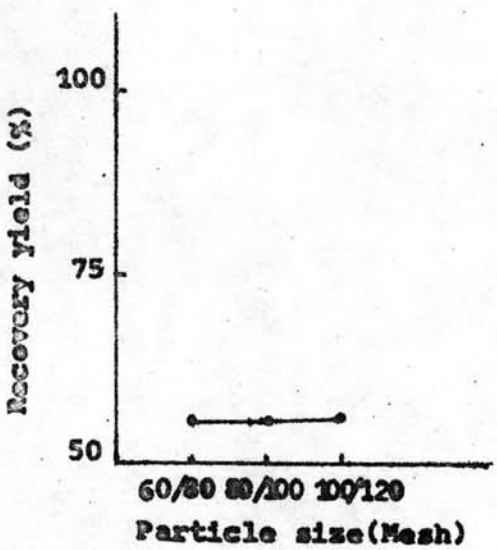


Fig. 4.24 : Pb

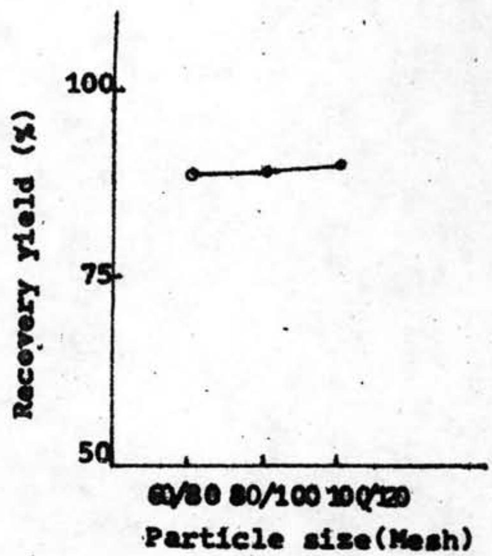


Fig. 4.25 : Zn

Table 4.19 The recovery yield of Cd, Cu, Pb and Zn at flow rate 2.0 $cm^3/_{min}$.

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	9.30	93.00	2	1.70	85.00	4	4.00	100.00	10	5.50	55.00
2	10	8.82	88.15	2	1.57	78.30	4	3.98	99.50	10	5.50	55.00
3	10	8.95	89.50	2	1.65	82.50	4	4.00	100.00	10	5.75	57.50
4	10	9.10	91.00	2	1.67	83.40	4	4.00	100.00	10	5.75	57.50
5	10	8.93	89.30	2	1.60	80.00	4	4.00	100.00	10	5.35	53.50
6	10	9.20	92.00	2	1.62	81.00	4	3.96	99.00	10	5.35	53.50
7	10	8.77	87.65	2	1.63	81.50	4	3.98	99.50	10	5.75	57.50
8	10	8.68	86.80	2	1.69	84.50	4	4.00	100.00	10	5.35	53.50
$\overline{X}$			89.68			82.03			99.75			55.38
SD			2.174			2.280			0.378			1.866
RSD			2.424			2.780			0.379			3.370

Table 4.20 The recovery yield of Cd, Cu, Pb and Zn at flow rate 6.0 $cm^3/_{min}$.

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	8.75	87.50	2	1.47	73.50	4	4.00	100.00	10	4.85	48.50
2	10	8.75	87.50	2	1.59	79.50	4	4.00	100.00	10	5.35	53.50
3	10	8.34	83.35	2	1.56	78.00	4	3.92	98.00	10	5.35	53.50
4	10	7.96	79.60	2	1.52	76.00	4	4.00	100.00	10	5.50	55.00
5	10	8.05	80.45	2	1.58	79.20	4	4.00	100.00	10	4.85	48.50
6	10	8.35	83.50	2	1.53	76.50	4	4.00	100.00	10	5.50	55.00
7	10	8.68	86.80	2	1.48	74.00	4	4.00	100.00	10	5.35	53.50
8	10	8.20	82.00	2	1.43	71.50	4	3.80	95.00	10	5.50	55.00
$\overline{X}$			83.84			76.03			99.13			52.81
SD			3.134			2.859			1.808			2.751
RSD			3.738			3.761			1.824			5.209

Table 4.21 The recovery yield of Cd, Cu, Pb and Zn at flow rate 8.0 $cm^3/_{min}$.

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	8.50	85.00	2	1.23	61.60	4	3.13	78.35	10	4.50	45.00
2	10	8.40	84.00	2	1.17	58.50	4	3.05	76.30	10	4.50	45.00
3	10	7.60	76.00	2	1.26	63.00	4	3.04	76.00	10	4.80	48.00
4	10	7.75	77.45	2	1.15	57.40	4	3.05	76.35	10	4.80	48.00
5	10	7.85	78.50	2	1.31	65.50	4	3.03	75.80	10	4.25	42.50
6	10	8.25	82.50	2	1.17	58.50	4	2.85	71.25	10	4.00	40.00
7	10	7.55	75.50	2	1.28	64.10	4	2.72	68.00	10	4.25	42.50
8	10	7.93	79.30	2	1.31	65.30	4	2.82	70.50	10	4.00	40.00
$\overline{X}$			79.79			61.75			74.07			43.88
SD			3.651			3.258			3.640			3.171
RSD			4.576			5.291			4.914			7.226

Fig. 4.26-4.29 Effect of flow rates on the recovery yield of Cd, Cu, Pb and Zn by reverse phase chromatography.

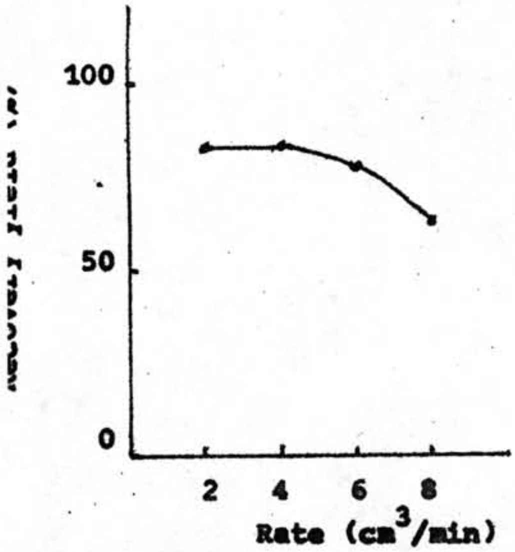


Fig. 4.26 : Cd

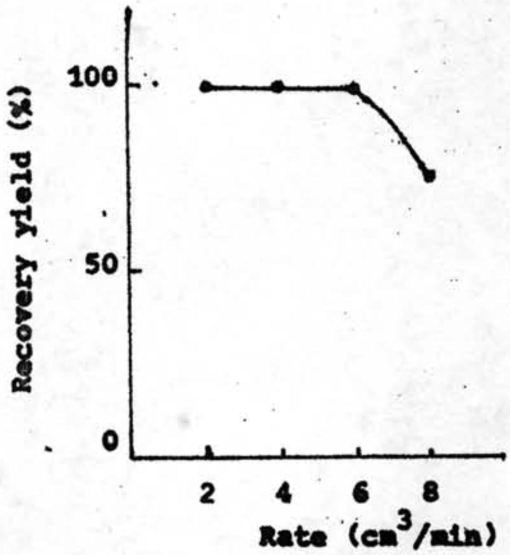


Fig. 4.27 : Cu

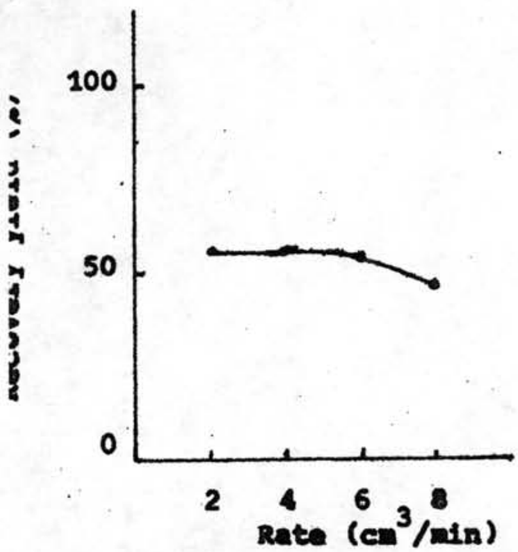


Fig. 4.28 : Pb

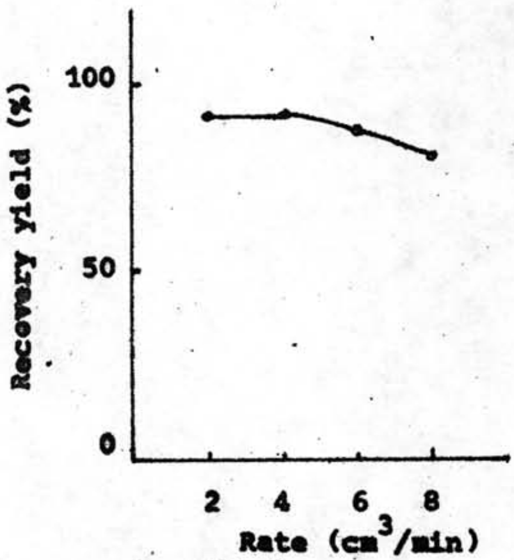


Fig. 4.29 : Zn

Table 4.22 The recovery yield of Cd, Cu, Pb and Zn.

Eluting agent : Benzene

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	8.85	88.50	2	1.67	83.60	4	3.12	78.00	10	5.15	51.50
2	10	8.20	82.00	2	1.59	79.50	4	3.22	80.50	10	5.15	51.50
3	10	8.80	88.00	2	1.64	82.00	4	3.07	76.70	10	5.50	55.00
4	10	8.65	86.50	2	1.52	75.80	4	3.16	79.00	10	5.50	55.00
5	10	8.10	81.00	2	1.57	78.50	4	3.14	78.50	10	5.50	55.00
6	10	8.25	82.50	2	1.62	81.20	4	3.04	76.00	10	4.80	48.00
7	10	8.45	84.50	2	1.52	76.00	4	3.20	80.00	10	4.80	48.00
8	10	8.55	85.50	2	1.57	78.40	4	3.11	77.80	10	5.15	51.50
$\bar{X}$			84.81			79.38			78.31			51.94
SD			2.802			2.777			1.533			2.921
RSD			3.304			3.498			1.957			5.623

Table 4.23 The recovery yield of Cd, Cu, Pb and Zn .

Eluting agent : Toluene

No of Experiment	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1	10	8.65	86.50	2	1.66	83.00	4	3.33	83.30	10	5.35	53.50
2	10	8.60	86.00	2	1.62	81.20	4	3.47	86.70	10	5.00	50.00
3	10	8.55	85.50	2	1.59	79.50	4	3.17	79.30	10	5.35	53.50
4	10	8.30	83.00	2	1.56	78.00	4	3.22	80.50	10	5.00	50.00
5	10	8.20	82.00	2	1.51	75.50	4	3.30	82.40	10	5.00	50.00
6	10	7.95	79.50	2	1.58	79.00	4	3.20	80.00	10	4.75	47.50
7	10	7.88	78.80	2	1.44	76.80	4	3.26	81.50	10	4.75	47.50
8	10	8.45	84.50	2	1.63	81.50	4	3.42	85.50	10	4.75	47.50
$\overline{X}$			83.23			79.31			82.40			49.94
SD			2.933			2.526			2.638			2.485
RSD			3.524			3.184			3.201			4.976

Fig. 4.30-4.33 Effect of eluting agents on the recovery yield of Cd, Cu, Pb and Zn by reverse phase chromatography.

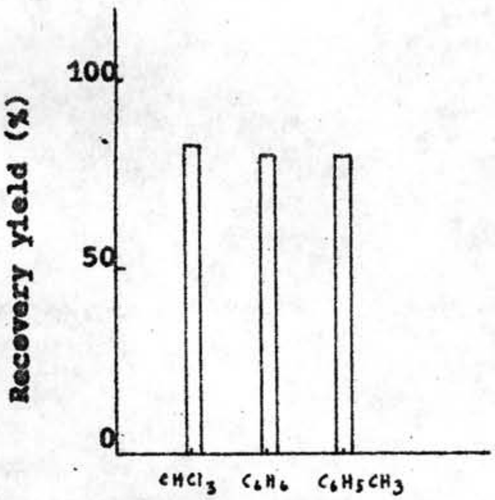


Fig. 4.30 : Cd

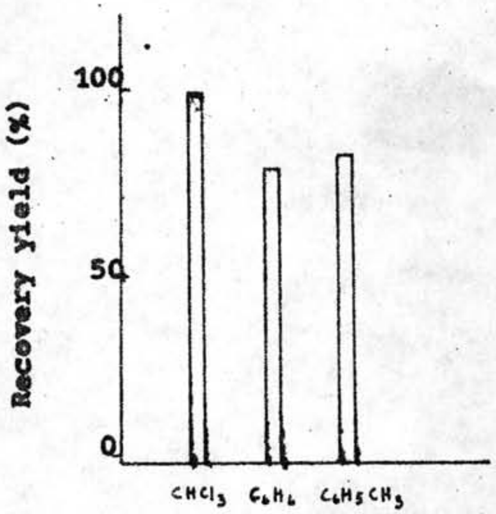


Fig. 4.31 : Cu

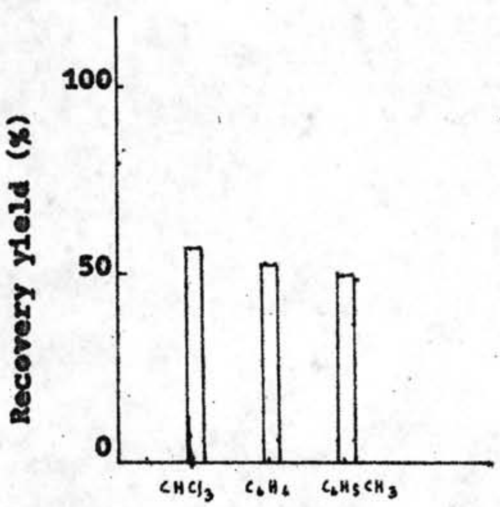


Fig. 4.32 : Pb

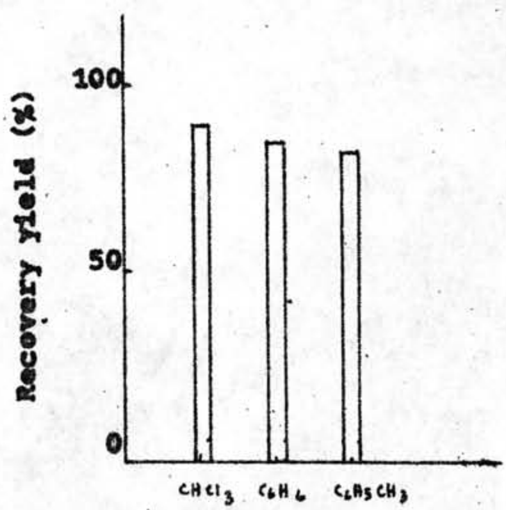


Fig. 4.33 : Zn

Table 4.24 The recovery yield of Cd, Cu, Pb and Zn at pH5.0 .

Stripping agent : Hydrochloric acid

Conc$^{\underline{n}}$ HCl Molarity	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
0.5	10	10.00	100.00	2	.24	12.00	4	-	-	10	-	-
0.5	10	10.00	100.00	2	.24	12.00	4	-	-	10	-	-
0.5	10	10.00	100.00	2	.26	13.00	4	-	-	10	-	-
0.5	10	10.00	100.00	2	.28	14.00	4	-	-	10	-	-
$\overline{X}$			100.00			12.75						
1.0	10	10.00	100.00	2	1.44	72.00	4	-	-	10	-	-
1.0	10	10.00	100.00	2	1.46	73.00	4	-	-	10	-	-
1.0	10	10.00	100.00	2	1.44	72.00	4	-	-	10	-	-
1.0	10	10.00	100.00	2	1.48	74.00	4	-	-	10	-	-
$\overline{X}$			100.00			72.75						
2.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	-	-
2.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	-	-
2.0	10	10.00	100.00	2	1.98	99.00	4	-	-	10	-	-
2.0	10	10.00	100.00	2	1.99	99.50	4	-	-	10	-	-
$\overline{X}$			100.00			99.63						

Table 4.24 The recovery yield of Cd, Cu, Pb and Zn.

Stripping agent : Hydrochloric acid

Conc$^{\underline{n}}$ HCl Molarity	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
3.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	7.00	70.00
3.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	7.50	75.00
3.0	10	10.00	100.00	2	1.99	99.50	4	-	-	10	7.50	75.00
3.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	7.50	75.00
$\bar{X}$			100.00			99.88						73.75
4.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
4.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
4.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
4.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
$\bar{X}$			100.00			100.00						100.00

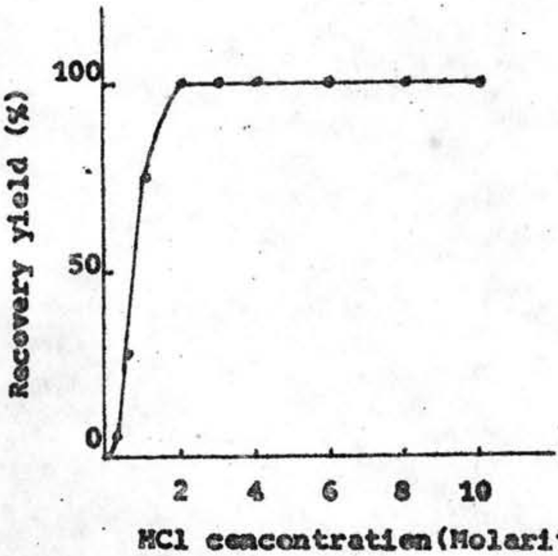
Table 4.24 The recovery yield of Cd, Cu, Pb and Zn.

Stripping agent : Hydrochloric acid

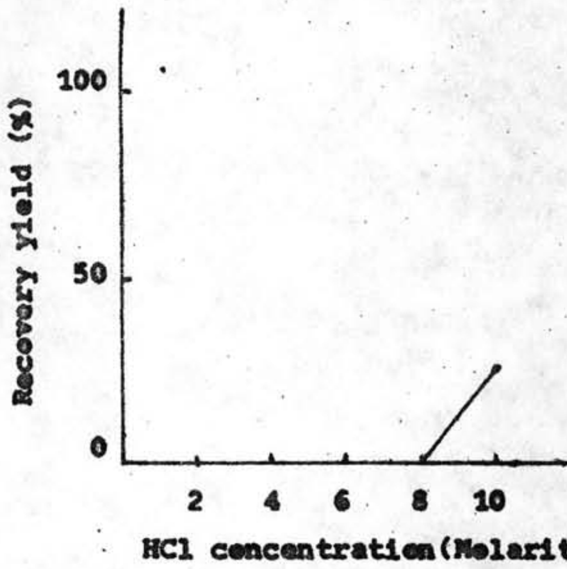
Conc^{n} HCl Molarity	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
6.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
6.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
6.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
6.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	10.00	100.00
$\bar{X}$			100.00			100.00						100.00
8.0	10	9.85	98.50	2	1.98	99.00	4	-	-	10	9.90	99.00
8.0	10	9.80	98.00	2	1.97	98.50	4	-	-	10	9.90	99.00
8.0	10	9.90	99.00	2	1.98	99.00	4	-	-	10	9.80	98.00
8.0	10	9.85	98.50	2	1.97	98.50	4	-	-	10	9.90	99.00
$\bar{X}$			98.25			98.75						98.75
10.0	10	9.75	97.50	2	1.96	98.00	4	1.00	25.00	10	9.70	97.00
10.0	10	9.70	97.00	2	1.95	97.50	4	1.00	25.00	10	9.70	97.00
10.0	10	9.70	97.00	2	1.95	97.50	4	1.00	25.00	10	9.70	97.00
10.0	10	9.75	97.50	2	1.95	97.50	4	1.00	25.00	10	9.70	97.00
$\bar{X}$			97.25			97.63			25.00			97.00

Note - : un detectable

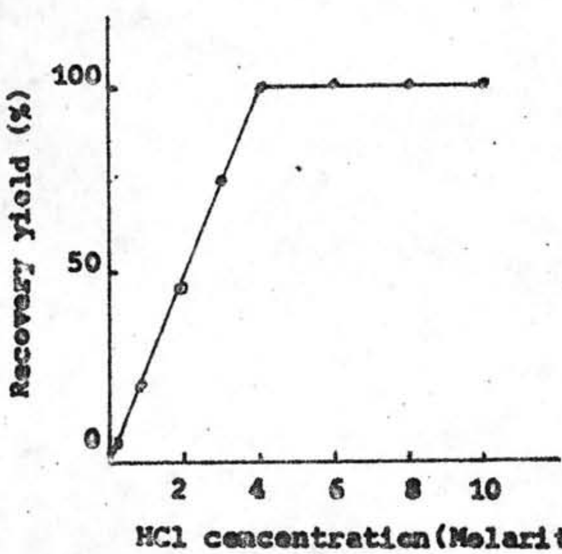
<u>Fig. 4.34-4.37</u> Effect of acid concentration on the stripping of Cd, Cu, Pb and Zn from chloroform.



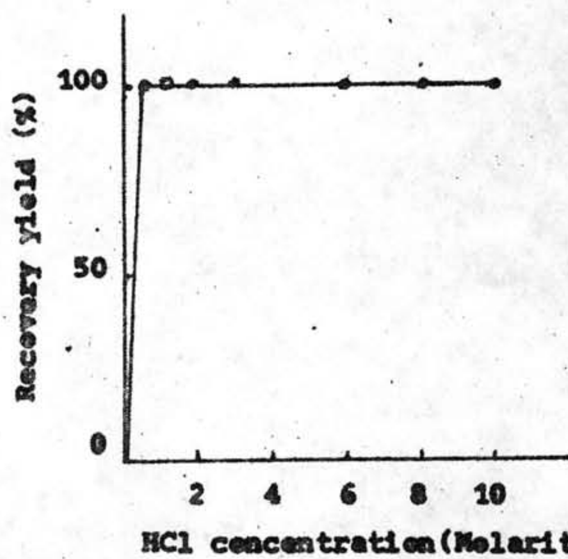
<u>Fig. 4.34</u> : Cd



<u>Fig. 4.35</u> : Cu



<u>Fig. 4.36</u> : Pb



<u>Fig. 4.37</u> : Zn

Table 4.25 The recovery yield of Cd, Cu, Pb and Zn at pH5.0.

Stripping agent : Nitric acid

Conc^{n} HNO_3 Molarity	Zn			Cd			Cu			Pb		
	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery	µg added	µg found	% Recovery
1.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	-	-
1.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	-	-
1.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	-	-
1.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	-	-
$\bar{X}$			100.00			100.00						
3.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	7.00	70.00
3.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	7.00	70.00
3.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	7.00	70.00
3.0	10	10.00	100.00	2	2.00	100.00	4	-	-	10	7.00	70.00
$\bar{X}$			100.00			100.00						70.00
5.0	10	10.00	100.00	2	2.00	100.00	4	3.40	85.00	10	10.00	100.00
5.0	10	10.00	100.00	2	2.00	100.00	4	3.40	85.00	10	10.00	100.00
5.0	10	10.00	100.00	2	2.00	100.00	4	3.36	84.00	10	10.00	100.00
5.0	10	10.00	100.00	2	2.00	100.00	4	3.36	84.00	10	10.00	100.00
$\bar{X}$			100.00			100.00			84.50			100.00

Table 4.25 The recovery yield of Cd, Cu, Pb and Zn .

Stripping agent : Nitric acid

Conc$^{\underline{n}}$ HNO_3 Molarity	Zn			Cd			Cu			Pb		
	μg added	μg found	% Recovery	μg added	μg found	% Recovery	μg added	μg found	% Recovery	μg added	μg found	% Recovery
6.0	10	10.00	100.00	2	2.00	100.00	4	4.00	100.00	10	10.00	100.00
6.0	10	10.00	100.00	2	2.00	100.00	4	4.00	100.00	10	10.00	100.00
6.0	10	10.00	100.00	2	2.00	100.00	4	4.00	100.00	10	10.00	100.00
6.0	10	10.00	100.00	2	2.00	100.00	4	4.00	100.00	10	10.00	100.00
$\overline{X}$			100.00			100.00			100.00			100.00
8.0	10	9.80	98.00	2	2.00	100.00	4	4.00	100.00	10	10.00	100.00
8.0	10	9.80	98.00	2	1.99	99.50	4	4.00	100.00	10	10.00	100.00
8.0	10	9.90	99.00	2	1.98	99.00	4	3.80	99.50	10	10.00	100.00
8.0	10	9.80	98.00	2	2.00	100.00	4	3.80	99.50	10	10.00	100.00
$\overline{X}$			98.25			99.63			99.75			100.00

Note - : un detectable

Fig. 4.38-4.41 Effect of acid concentration on the stripping of Cd, Cu, Pb and Zn from chloroform .

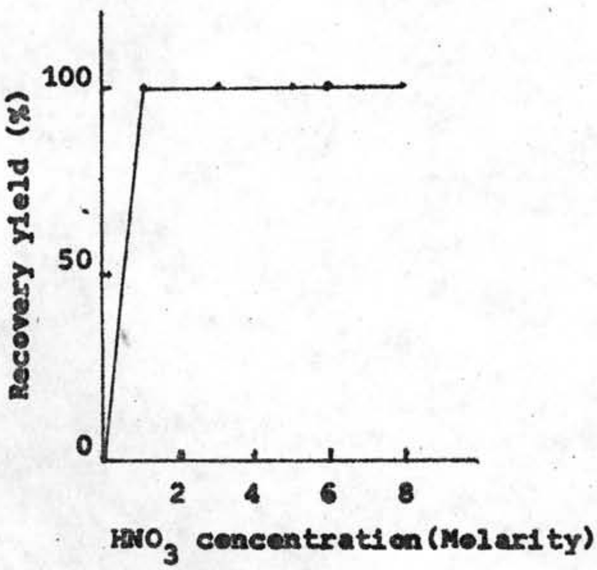


Fig. 4.38 : Cd

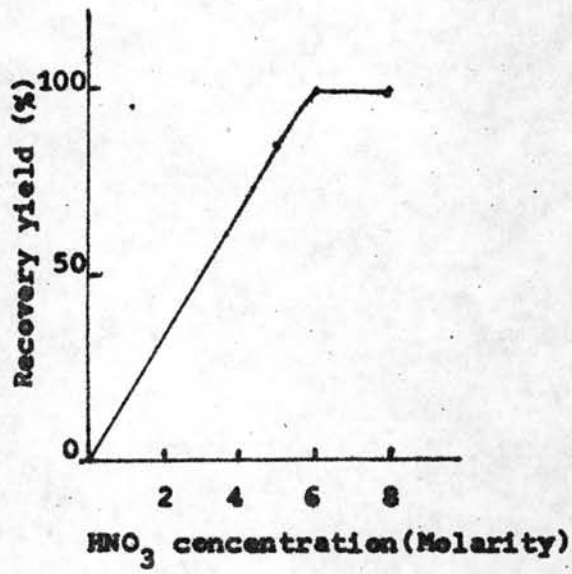


Fig. 4.39 : Cu

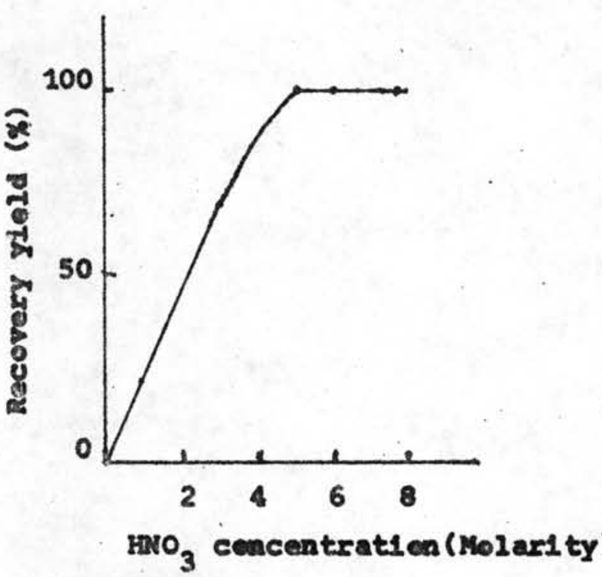


Fig. 4.40 : Pb

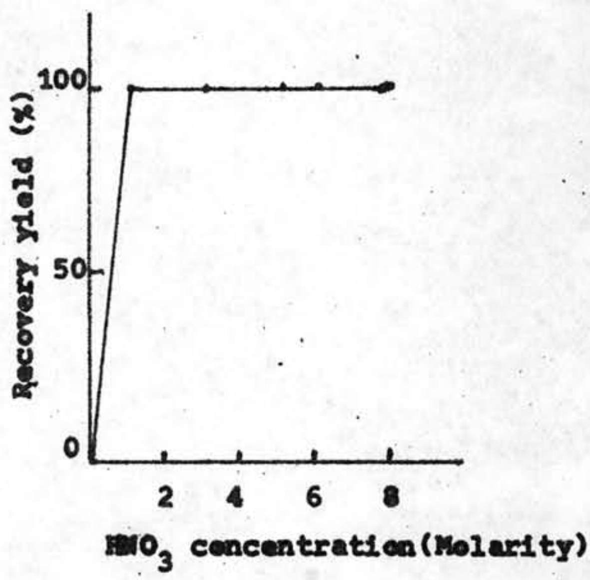


Fig. 4.41 : Zn

Table 4.26 Concentration of Cd, Cu, Pb and Zn in 5 samples of sea water after preconcentration by chelex-100.

Sample No	No of Experiment	Zn µg/4dm^3	Zn µg/dm^3 (ppb)	Cd µg/4dm^3	Cd µg/dm^3 (ppb)	Cu µg/4dm^3	Cu µg/dm^3 (ppb)	Pb µg/4dm^3	Pb µg/dm^3 (ppb)
1	1	158.76	39.69	0.461	0.115	10.36	2.59	4.89	1.22
	2	163.58	40.89	0.468	0.117	10.49	2.62	4.56	1.14
	3	159.73	39.93	0.453	0.113	10.73	2.68	4.67	1.17
2	1	113.96	28.49	0.436	0.109	10.05	2.51	3.53	0.88
	2	106.07	26.52	0.423	0.106	9.96	2.49	3.24	0.81
	3	109.23	27.31	0.421	0.105	10.02	2.50	3.31	0.83
3	1	87.26	21.82	0.412	0.103	8.97	2.24	3.05	0.76
	2	88.76	22.19	0.393	0.098	8.84	2.21	3.53	0.88
	3	92.53	23.13	0.405	0.101	9.05	2.26	3.23	0.81
4	1	101.82	25.46	0.377	0.094	9.29	2.32	3.07	0.77
	2	105.42	26.36	0.360	0.090	8.86	2.21	2.92	0.73
	3	110.74	27.69	0.348	0.087	8.97	2.24	3.17	0.79
5	1	87.90	21.98	0.393	0.098	8.54	2.14	3.13	0.78
	2	85.48	21.37	0.372	0.093	8.65	2.16	3.21	0.80
	3	82.40	20.60	0.341	0.085	8.37	2.09	3.05	0.76

Table 4.27 Concentration of Cd, Cu, Pb and Zn in 5 samples of sea water after preconcentration by reverse phase chromatography.

Sample No	No of Experiment	Zn		Cd		Cu		Pb	
		$\mu g/dm^3$ obtained	$\mu g/dm^3$ after correction for chemical yield	$\mu g/dm^3$ as obtained	$\mu g/dm^3$ after correction for chemical yield	$\mu g/dm^3$ as obtained	$\mu g/dm^3$ after correction for chemical yield	$\mu g/dm^3$ as obtained	$\mu g/dm^3$ after correction for chemical yield
1	1	31.78	35.50	0.094	0.107	2.72	2.72	0.56	1.00
	2	33.54	37.46	0.089	0.101	2.81	2.81	0.57	1.03
2	1	22.29	24.89	0.084	0.095	2.60	2.60	0.43	0.78
	2	23.50	26.25	0.081	0.101	2.71	2.71	0.38	0.69
3	1	18.31	20.45	0.083	0.094	2.28	2.28	0.36	0.65
	2	16.45	18.37	0.080	0.091	2.35	2.35	0.39	0.71
4	1	21.11	23.56	0.075	0.085	2.34	2.34	0.37	0.67
	2	19.47	21.75	0.070	0.079	2.39	2.39	0.33	0.60
5	1	18.24	20.37	0.077	0.087	2.22	2.22	0.33	0.61
	2	16.65	18.59	0.070	0.079	2.31	2.31	0.39	0.70

Table 4.28 Concentration of Cd, Cu, Pb and Zn in 5 samples of sea water by chelex-100 and by reverse phase chromatography.

Sample No	No of Experiment	Zn		Cd		Cu		Pb	
		chelex-100 (ppb)	Reverse phase(correction) (ppb)	chelex-100 (ppb)	Reverse phase(correction) (ppb)	chelex-100 (ppb)	Reverse phase(correction) (ppb)	chelex-100 (ppb)	Reverse phase(correction) (ppb)
1	1	39.69	35.50	0.115	0.107	2.59	2.72	1.22	1.00
	2	40.89	37.46	0.117	0.101	2.62	2.81	1.14	1.03
	3	39.93		0.113		2.68		1.17	
2	1	28.94	24.89	0.109	0.095	2.51	2.60	0.88	0.78
	2	26.52	26.25	0.106	0.101	2.49	2.71	0.81	0.69
	3	27.31		0.105		2.50		0.83	
3	1	21.82	20.45	0.103	0.094	2.24	2.28	0.76	0.65
	2	22.19	18.37	0.098	0.091	2.21	2.35	0.88	0.71
	3	23.13		0.101		2.26		0.81	
4	1	25.46	23.56	0.094	0.085	2.32	2.34	0.77	0.67
	2	26.36	21.75	0.090	0.079	2.21	2.39	0.73	0.60
	3	27.69		0.087		2.24		0.79	
5	1	21.98	20.37	0.098	0.087	2.14	2.22	0.78	0.61
	2	21.37	18.59	0.093	0.079	2.16	2.31	0.76	0.70
	3	20.60		0.085		2.09		0.80	