Studies on the Seasonal Variation of Heavy Metal Content of Coastal Waters Adjacent to Manakudy Estuarine Region, South West Coast of India.

V. LOLA CATHERINE[1], H. MARY HELEN[2]

[1.]Research Scholar, Department of Chemistry, S.T. Hindu College, Nagercoil, T.N, India.
[2.]Assistant Professor, Department of Chemistry, S.T. Hindu College, Nagercoil, T.N, India.
Address of Corresponding Author: V.Lola Catherine, Melai thetty veedu, Meenachal P O
Corresponding Author Email : lolacatherinev@gmail.com

Abstract

Water samples were collected for a period of one year from October - 2016 to September – 2017. Five different sampling stations were selected. Heavy metals such as Mn, Fe, Pb, Cu, Zn, Cd and Hg were analysed using AAS. High levels of Mn, Fe, Zn and Cd were observed at the station 1. The order of heavy metal content in the water samples was: Mn > Zn > Fe > Cu > Pb > Cd. Hg was absent in all the five stations.

Keywords: Heavy metals, water, Manakudy estuary, AAS, Seasonal variation.

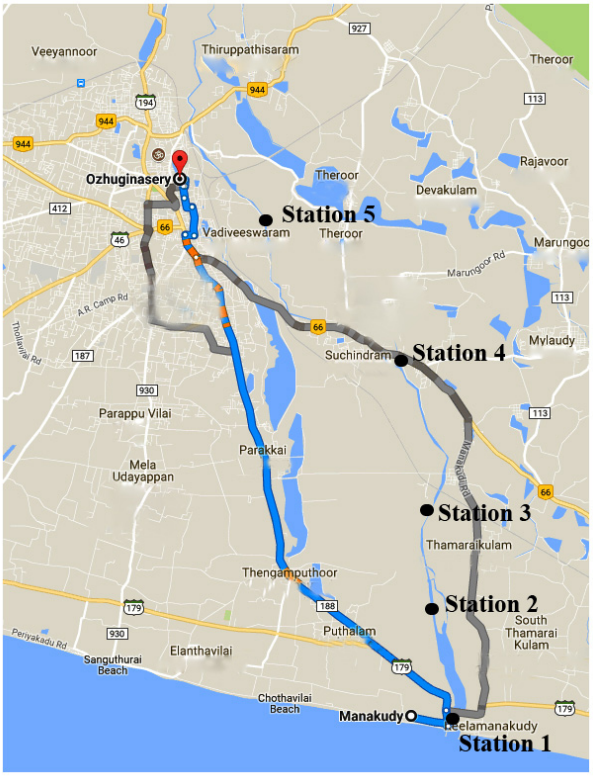
Introduction

Estuaries are the meeting place of saltwater from the sea and freshwater from rivers, are dynamic environments characterized by large fluctuations in environmental conditions [1]. Heavy metals are common pollutants which are distributed in aquatic environment. There are some sources from which water bodies are getting polluted through heavy metals. They may occur due to industrial, anthropogenic and agricultural wastes [2, 3]. Heavy metals occur naturally in the ecosystem with larger variation in the concentration. Even though some heavy metals form the part of our daily life activities, they are subjected to potent toxics, contaminating ecosystems. Some heavy metals like iron, cobalt, copper, manganese, molybdenum and zinc are essential to the human body to maintain the metabolism, but its excessive levels can be damaging to the organism. Heavy metals concentrations in aquatic ecosystems are usually monitored by measuring their concentrations in water, sediments and biota [4]. Pollution by heavy metals is a serious problem due to their toxicity and ability to accumulate in the biota [5]. Metal pollution has a harmful effect on biological systems and does not undergo biodegradation and accumulate in living organisms, thus causing various diseases and disorders even in relatively lower concentrations [6]. Heavy metals constitute one of the most dangerous groups because of their persistent nature, toxicity, tendency to accumulate in organisms and undergo food chain amplification and eventually threaten the health of humans that consume them and they are non-degradable [7]. Metals generally enter the aquatic environment through atmospheric deposition, erosion of geological matrix or due to anthropogenic activities caused by industrial effluents, domestic sewage and mining wastes [8]. The objectives of this work are to find out the heavy metal concentrations present in the water.

Description of Study Area

The Manakudy estuary is the second largest estuary in Kanyakumari District. It has a total area of 145 hectares. Manakudy estuary is situated about 8 kilometers north west of cape Comorin falling within the latitude $8^{o}4'$ and $8^{o}21'$ N and longitude $77^{o}26'$ and $77^{o}30'$ E. The climate of the region is greatly

influenced by both South West and North East monsoons. The tail end of Pazhayar River merges with the Arabian Sea at Manakudy. The river originates at the Western Ghats, flowing through Surlodu, Azhagiapandipurum, Ozhiginasery, Suchindrum, Thamaraikulam finally destinating at Manakudy covering a distance of 67kms. It is a sand built estuary connected to the sea during the rainy season. During the period of total occlusion of the river mouth, the estuarine water swells due to heavy inflow of water from the head of the estuary and also by the land drainage. During heavy inflow into the estuary the sand bar opens up under the force of gravity. Compared to the expanse of the estuarine area, the bar mouth is relatively small and even during summer months the local people cut open the bar mouth and the estuary has open access to the sea. The location map of Manakudy estuary is shown in fig 1. Station 1 is located at the mouth of the estuary, Station 2 is Puthalam which is 6 km away from station 1, Station 3 is Thamaraikulam which is 10 km away from station 1, Station 4 is Suchindrum, which is 14 km away from station 1 and Station 5 is Ozhiginasary which is 18 km away from station 1.



Station 1
Manakudy Estuary

Station 2
Puthalam

Station 3
Thamaraikulam

Station 4
Suchindrum

Station 5
Ozhuginasery

Materials and Methods

Water samples were collected for a period of one year from October 2016 – September 2017. Five sampling stations representing different ecological conditions were chosen for collection of water samples in the Manakudy estuary from estuarine mouth bed to Ozhuginasery river basin. Sampling was done usually during the morning hours between 9.00 am to 11.00 am. Water samples were collected by using 3 liter polyethylene plastic containers. Heavy metals like Fe, Pb, Cu, Zn, Cd and Mn were analysed using Atomic Adsorption spectrometer (UNICAM 939). Hg was determined by cold vapour Atomic Adsorption Spectrometer (Varian Techtron Model, AA6).

Results and Discussion

Seasonal variation of heavy metals are given in Tables 1, 2 and 3.

Table 1 Variation of heavy metal content of water samples recorded at Manakudy estuary during post monsoon season.

Heavy metals	Stations				
	S1	S2	S3	S4	S5
Fe (mg/l)	3.69 ± 0.04	3.62 ± 0.09	3.45 ± 0.12	3.36 ± 0.78	3.64 ± 0.27
Pb (mg/l)	0.14 ± 0.01	0.15 ± 0.02	0.25 ± 0.02	0.25 ± 0.02	0.24 ± 0.02
Cu (mg/l)	0.42 ± 0.04	0.55 ± 0.03	0.37 ± 0.04	0.42 ± 0.02	0.40 ± 0.07
Zn (mg/l)	7.22 ± 0.35	7.33 ± 0.15	7.05 ± 0.60	6.43 ± 0.28	6.48 ± 0.21
Cd (mg/l)	0.33 ± 0.038	0.32 ± 0.038	0.13 ± 0.004	0.13 ± 0.0005	0.12 ± 0.002
Mn (mg/l)	14.75 ± 1.50	15.25 ± 2.62	12.50 ± 2.08	9.25 ± 1.89	8.75 ± 0.50
Hg (mg/l)	ND	ND	ND	ND	ND

Table 2 Variation of heavy metal content of water samples recorded at Manakudy estuary during pre monsoon season.

Heavy metals	Stations				
	S1	S2	S3	S4	S5
Fe (mg/l)	4.28 ± 0.07	3.97 ± 0.21	3.71 ± 0.08	3.59 ± 0.06	3.66 ± 0.09
Pb (mg/l)	0.34 ± 0.02	0.32 ± 0.02	0.42 ± 0.03	0.43 ± 0.02	0.42 ± 0.02
Cu (mg/l)	0.39 ± 0.06	0.61 ± 0.04	0.39 ± 0.02	0.38 ± 0.07	0.38 ± 0.01
Zn (mg/l)	7.40 ± 0.14	7.30 ± 0.08	6.90 ±0.71	6.77 ± 0.05	6.70 ± 0.08
Cd (mg/l)	0.17 ± 0.003	0.19 ± 0.003	0.13 ± 0.004	0.24 ± 0.031	0.006 ± 0.0005
Mn (mg/l)	18.25 ± 0.96	16.50 ± 1.29	13.25 ± 3.20	12.00 ± 0.81	10.75 ± 0.95
Hg (mg/l)	ND	ND	ND	ND	ND

Table: 3 Variation of heavy metal content of water samples recorded at Manakudy estuary during monsoon season.

Heavy metals	Stations				
	S1	S2	S3	S4	S5
Fe (mg/l)	4.66 ± 0.16	4.34 ± 0.33	3.97 ± 0.49	3.71 ± 0.15	4.63 ± 0.19
Pb (mg/l)	0.45 ± 0.02	0.49 ± 0.02	0.54 ± 0.02	0.57 ± 0.02	0.56 ± 0.04
Cu (mg/l)	0.50 ± 0.05	0.68 ± 0.03	0.54± 0.03	0.59 ± 0.04	0.38 ± 0.05
Zn (mg/l)	8.00 ± 0.21	7.02 ± 0.63	7.25 ± 1.45	6.62 ± 0.46	6.87 ± 0.09
Cd (mg/l)	0.24 ± 0.0009	0.17 ± 0.003	0.13 ± 0.004	0.008 ± 0.001	0.008 ± 0.0009
Mn (mg/l)	21.75 ± 0.95	18.75 ± 0.96	14.00 ± 1.82	11.00 ± 1.63	10.00 ± 2.16
Hg (mg/l)	ND	ND	ND	ND	ND

Fe

In the present study, the value of Fe in water samples varied from 3.25 – 4.83 mg/l. Maximum value of Fe was recorded in monsoon season at station 1 (4.66 ± 0.16) and minimum value was recorded in post monsoon season at station 4 (3.36 ± 0.78). The high value of Fe was due to mining and corroded bridge was near the estuary.

Pb

The value of lead in water samples varied from 0.11 – 0.59 mg/l. Maximum value of Pb was recorded in monsoon season at station 4 (0.56 ± 0.02) and minimum value was recorded in post monsoon season at station 1 (0.14 ± 0.02). Presence of lead is due to household wastes like pipes, batteries, plastics, paints and natural deposits. Similar study reported by [9].

Cu

In the present study the range of heavy metal Cu was 0.32 – 0.71 mg/l. Maximum value of Cu was observed in monsoon season at station 2 (0.68 ± 0.03) and minimum value was recorded in post monsoon season at station 3 (0.37 ± 0.04). Maximum value is due to the flow of the dredged materials from upper regions of the rivers, dilution and increase of water flow, direct drainage from farmland, sewage disposal plants [10].

Zn

Zn value of water varied from 8.2 – 6.1 mg/l. Maximum value of Zn was detected in monsoon season at station 1 (8.00 ± 0.21) and minimum value was recorded in post monsoon season at station 4 (6.43 ± 0.28). It is mainly due to the presence of unused remains of zinc sulphate in fertilizers and anthropogenic activities. Similar results reported by [11].

Cd

The value of Cd in water samples varied from 0.006 – 0.024 mg/l. Maximum value of Cd was recorded in post monsoon season at station 1 (0.33 ± 0.04) and minimum value was recorded in pre monsoon season at station 5 (0.0063 ± 0.0005). It may be due to agricultural discharges and domestic wastes. Similar study was reported by[12].

Mn

Mn content of water varied from 7 – 23 mg/l. Maximum value of Mn was observed in monsoon season at station 1 (21.75 ± 0.95) and minimum value was recorded in post monsoon season at station 5 (8.75 ± 0.500). Mn is mainly due to anthropogenic sources such as sewage sludge, municipal waste water discharges and mining. Some reports have indicated that the presence of Mn in water can increase the toxicity levels of other metals, particularly Cd [13]. Mn intoxication has also been documented after the ingestion of pollution water [14].

Hg

Hg was not detected in all the five sampling stations through out the study period.

Conclusions

From the present study it was clear that the estuarine region was contaminated by heavy metal pollution. Higher level of Mn, Fe, Zn and Cd were observed at the station 1 and high levels of Cu and Pb were observed at station 2 and station 4. The order of heavy metals concentration was given as Mn > Zn > Fe > Cu > Pb > Cd. Hg was absent. The presence of heavy metals in the water samples were mainly due to the anthropogenic activities, agricultural wastes, mining and household wastes. Concentration of the various heavy metals differs from one river to another probably because of the variation in the quality of domestic, sewage and industrial wastes being added to the rivers. If proper measures are taken for the treatment of sewage before discharge and restrictions are carried on various anthropogenic activities the health of the Manakudy estuary can be maintained.

References

[1] N.C. James, P.D. Cowley, A.K. Whitfield, S.J. Lamberth, "Reviews in Fish Biology and Fisheries", 17, pp. 565-580, 2007.

[2] P. Shrivastava, A. Saxena and A. Swarup, "Heavy metal pollution in sewage fed Lake of Bhopal, M.P, India", Lake Reservoir Research Management, 8, pp. 1- 4, 2001.

[3] M.S. Kambole, "Managing the water quality of Kafue river. In: Water demand management for sustainable development", 3rd water werfsa symposium, Dare s Salaam, pp. 1 – 6, 2002.

[4] F.A. Oguzie, "Heavy metals in fish, water and effluents of lower Ikpoba River in Benin City, Nigeria", Pak. J. Sci. Indust. Res., 46, pp. 156 -160, 2003.

[5] M. Shahidul Islam and M. Tanaka, " Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: a review and synthesis", Mar. Pollut. Bull., 48, pp. 624 – 649, 2004.

[6] E. Pehlivan , A.M. Ozkan, S. Dinc and S. Parlayici, "Adsorption of Cu 2+ and Pb2+ ion on dolomite power", J. Hazard Mater., 167, pp. 1044 – 1049, 2009.

[7] P. Tawari Fufeyin and A.B. Egborge, "Heavy Metals of Ikpoba River, Benin, Nigeria", Tropical Freshwater Biol., 7, pp. 27 – 36, 1998.

[8] Das, B. Mandal, J. Sarkar and S. Chaudhuri, "Bioaccumulation of heavy metals in some commercial fishes and crabs of the Gulf of Cambay", India. Curr. Sci., 92, pp. 1489 – 1491, 2007.

[9] M.G.M. Alam, A. Tanaka, G. Allinson, L.J.B. Laurenson, F. Stagnitti and E. Snow, "A comparison of trace element concentrations in cultured and wild crap (cyprinus carpio) of Lake Kasumigaura Japan", Ecotoxicol. Environ. Safe., 53, pp. 348 – 354, 2002.

[10] M. Fikrat, M. Hassan, M. Saleh and M.S. Jusim, "CODEN ECJHAO", E – J Chemistry., 7, pp. 0973 – 4945, 2010.

[11] Y.F. Wu, C.Q. Liu and C.L. Tu, "Atmospheric deposition of metals in TSP of guiyang, PR China", Bull. Environ. Contam. Toxicol., 80(5), pp. 465 – 468, 2008.

[12] S. Chakraborty, T. Bhatta Charya, G. Singh and J.P. Maity, "Benthic macroalgae as biological indicator of heavy metal pollution in the marine environment: A biomonitoring approach for pollution assessment", Ecotoxic. Environ. Safety., 100, pp. 61 – 68, 2014.

[13] Kabata – Pendias and A.B. Mukherjee, "Trace elements from soil to human", Springer Science & Business, New York, USA., pp. 200, 2007.

[14] H.K. Hudnell, "Effects from environmental Mn exposures: a review of the evidence from non – occupational exposure studies, Neurotoxicology", 20 (2 – 3), pp. 379 – 397, 1998.