International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Seasonal Dynamics of Heavy Metals in Dal Lake and Nigeen Lakes of Kashmir Valley

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ABSTRACT

Comparison of the two lakes on the basis of studied water chemistry parameters revealed that Dal lake is more polluted than Nigeen lake as reflected by the values of water transparency, dissolved oxygen, total alkalinity, magnesium content, sulphate content, nitrate and ammonical nitrogen contents, orthophosphate and total phosphate contents but in case of conductivity, calcium contents, chloride content, and total TDS values Nigeen lake dominated the scene.

Key Words: Kashmir Lakes, Pollution, Heavy Metals and seasonal Dynamics.

1. Introduction

Water is not only life sustaining natural resource on earth but all socio-economic developments and human welfare depends on it. Hence the availability of this valuable resource in pure and usable forms is crucial. Inspite of its vital importance, it is invariably polluted by both natural and anthropogenic sources. Amongst various polluting species in natural water bodies, the most dreaded and ever increasing are the heavy metals, which are more dangerous than other toxicants because of the fact that they are native to human body due to which they bioaccumulate over time whenever they are taken up and get stored faster than they are metabolized or excreted.

2. Water Chemistry & Pollution Status Studies

Both the water bodies are polluted in terms of majority of the water chemistry parameters studied, ranging from high values of total alkalinity, conductivity, chloride content, nitrate content, ammonia content, total dissolved solids, orthophosphate and total phosphate contents to low levels of water transparency and dissolved oxygen contents.

Comparison of the two lakes on the basis of studied water chemistry parameters revealed that Dal lake is more polluted than Nigeen lake as reflected by the values of water transparency, dissolved oxygen, total alkalinity, magnesium content, sulphate content, nitrate and ammonical nitrogen contents,

orthophosphate and total phosphate contents but in case of conductivity, calcium contents, chloride content, and total TDS values Nigeen lake dominated the scene.

3. Review of Literature

The distributional pattern of heavy metals within a natural fresh water lake is a result of various processes taking place in concert within the water column of the lake, at the sediment water interface, in sediments, catchment area effects, biological productivity and formation of hydrous oxides (Feitkneet and Schindler[1]; Theobold et al.[2]; Singer[3]; Salomons and Moonk[4]; Duruibe et al[5]). The processes controlling the heavy metal concentrations of water columns in natural fresh water bodies are well known but the relative importance of the different processes in poorly quantified. The release of heavy metals from sediments to water column in the water bodies depends on the speciation of heavy metals (i.e. metals may be precipitated, complexed, absorbed or solubilized) and other factors such as sediment pH and other physico-chemical characteristics of the aquatic systems (Morgan and stumn[6]. These heavy metals may distribute in sediments as exchangeable, carbonate bound, iron manganese oxide bound, organic matter bound and residual bound species.

4. Methodology

Sediment samples were collected from all the selected sites of the two water bodies (twelve sites; nine from Dal Lake (D-1) and three from Nigeen lake (D2) using Ekman Dredge sampler and the samples were collected by Grab sampling process. The sampling procedure, treatment of samples collected and the analyses of the sediment samples for heavy metal determination were done as per the standard methods given by Ganapathy et al, Golterman and Clymo and APHA.

5. *Results and Discussion*

From the perusal of data tables (1 & 2), it is observed that the concentration of heavy metals in the water of two lakes is in the following order:

Zn > Fe > Co > Mn > Cu > Pb > Ni in Dal Lake and

Fe > Zn > Co > Mn > Cu > Pb > Ni in Nigeen Lake

With regard to the heavy metal concentration, a definite gradation has been observed within the two lake systems. Both the water bodies showed increase in the concentration of manganese, iron, cobalt, nickel, copper and lead in going from winter to spring seasons which is in tune with the fact that high terrestrial run-off; snow melts, storm water run-off and leached waters from catchment areas

having high concentration of these metals, make their way to these lakes. Besides increasing temperatures in going from winter to spring seasons, enhance the heavy metals content of water column by facilitating their more dissolution. The low summer content of these heavy metals in both the water bodies is probably due to their rapid uptake by macrophysics because of their growth activities being at peak during summer season in this region and also due to dilution effects.

Table-1

Seasonal dynamics of heavy metals in Dal Lake (D-1) from March-2006 to Feb. 2007 & March 2007 to Feb. 2008

March 2006 to February 2007						*March 2007 to February 2008*					
Spring	*Summer*	*Autumn*	*Winter*	*Mean*	*S. D.*	*Spring*	*Summer*	*Autumn*	*Winter*	*Mean*	*S. D.*
15	*8*	*6*	*4*	*8*	*5*	*4*	*5*	*4*	*4*	*4*	*1*
39	*34*	*50*	*37*	*40*	*7*	*36*	*38*	*36*	*35*	*37*	*1*
B.D	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*
47	*36*	*53*	*19*	*39*	*15*	*63*	*61*	*67*	*22*	*53*	*21*
183	*346*	*172*	*301*	*251*	*86*	*233*	*406*	*387*	*111*	*284*	*139*
37	*53*	*67*	*29*	*47*	*17*	*51*	*62*	*76*	*42*	*58*	*15*

26	*11*	*B.D*	*21*	*19*	*8*	*40*	*24*	*11*	*38*	*28*	*14*
47	*13*	*41*	*30*	*33*	*15*	*61*	*16*	*57*	*36*	*43*	*21*
31	*109*	*203*	*197*	*135*	*82*	*39*	*122*	*210*	*203*	*144*	*80*
B.D	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*
37	*21*	*31*	*11*	*25*	*11*	*51*	*35*	*49*	*14*	*37*	*17*
B.D	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*

Table-2

March 2006 to February 2007						*March 2007 to February 2008*					
Spring	*Summer*	*Autumn*	*Winter*	*Mean*	*S. D.*	*Spring*	*Summer*	*Autumn*	*Winter*	*Mean*	*S. D.*
3	*4*	*6*	*4*	*4*	*1*	*3*	*4*	*4*	*3*	*3*	*0*
30	*33*	*30*	*34*	*32*	*2*	*32*	*32*	*33*	*34*	*33*	*1*
B.D	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*

53	*39*	*73*	*17*	*46*	*24*	*67*	*42*	*79*	*21*	*52*	*26*
174	*364*	*207*	*265*	*253*	*83*	*194*	*134*	*102*	*99*	*132*	*44*
43	*53*	*65*	*32*	*48*	*14*	*51*	*61*	*78*	*41*	*58*	*16*
38	*12*	*B.D*	*27*	*26*	*13*	*45*	*14*	*B.D*	*44*	*34*	*18*
68	*12*	*48*	*33*	*40*	*24*	*76*	*17*	*75*	*37*	*51*	*29*
35	*99*	*678*	*649*	*365*	*346*	*38*	*104*	*690*	*663*	*374*	*351*
B.D	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*
57	*22*	*37*	*B.D*	*39*	*18*	*64*	*24*	*65*	*10*	*41*	*28*
B.D	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*	*B.D*

Table-2

Seasonal dynamics of heavy metals in Nigeen Lake (D-2) from March-2006 to Feb. 2007 & March 2007 to Feb. 2008

Note: (B.D=below detection limits S.D= standard deviation)

Concentration of manganese, iron and cobalt were maximum in autumn and minimum during winter seasons. In case of nickel, copper and lead upper concentrations were observed in spring and the minimum concentrations were observed in summer seasons whereas zinc showed minimum concentration in spring and maximum concentration during autumn seasons. Zinc showed another

contrasting behaviour, being the most concentrated heavy metal in Dal lake as compared to iron in Nigeen lake where it seconded iron.

Higher values of zinc concentration observed in the water column of both the lakes besides other factors may be due to the fact that it prevails in high concentration in most of dust, air and water samples in urban environment and exhibits highest mobility and potential bioavailability, besides due to its use as coatings on copper utensils most extensively used in Kashmir valley.

Concentrations of these heavy metals in lake waters is also influenced by the fact that following their entry to the water bodies these heavy metals are efficiently scavenged by iron and manganese oxy hydroxides, which along with the particulate organic matter govern the behaviour of these heavy metals in the water column . The oxidization process of Fe (II) to Fe (III) takes a few hours at pH 5 while at pH 7 and above only few minutes are required (Stumn and Lee[7]) with the depletion of oxygen in summer and the appearance of anoxic conditions in both the lakes, the concentration of soluble Fe (II) and Mn (II) increases at the expense of Fe(III) and Mn(IV) from the sediments. These conditions may account for the high concentration of these heavy metals towards the autumn season.

The release of heavy metals from sediments to water column in the water bodies depends on the speciation of heavy metals (i.e. metals may be precipitated, complexed, absorbed or solubilized) and other factors such as sediment pH and other physico-chemical characteristics of the aquatic systems (Morgan and stumn). These heavy metals may distribute in sediments as exchangeable, carbonate bound, iron manganese oxide bound, organic matter bound and residual bound species.

The seasonal variation of calcium and magnesium were in tune with their allochthonous inputs besides the endogenic origin except some irregularities at a few sites, may be due to differential inputs during the sampling days.

All these variations in concentration of said metals may be due to the changes in the inflow of terrestrial run-off, agricultural run-off, human and animal wastes and run-off with leaching from catchment areas which may be responsible for higher concentrations of these heavy metals in springs. For low levels observed in winter the sedimentation of heavy metals and low releasing capacity of the system because of low microbiological activity at lower temperatures may be a plausible explanation. The changes may also be due to combined effect of changes in pH, temperature and dissolved oxygen besides other influencing parameters because the systems studied are real natural water systems where a host of factors operate together with synergistic modus operandi.

6. Conclusion

The results of study revealed that giving the comparative account of concentrations of the analyzed heavy metals during present study and the maximum allowable concentrations (MAC) of these heavy metals in such fresh water bodies for maintenance of aquatic life, it gets reflected that the concentrations of zinc and lead are above the limits for both the water bodies whereas for other the values are within limits. Moreover, the concentrations of nickel and copper are also above the allowable limits at many individuals sites in both the water bodies, but did not get reflected in the comparative account as the values given are the mean concentrations.

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