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DETERMINATION OF CHLORIDE ION(Cl^-) CONCENTRATION IN GANGA RIVER WATER BY MOHR METHOD AT KANPUR, INDIA

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Abstract

Purpose of the study: The purpose of this present study was determine the concentration of chloride ion in water sample which collected different site and season of river Ganga.Chloride ions in the environment can come from sodium chloride or from other chloride salts such as potassium chloride, calcium chloride and magnesium chloride.

Methodology: Water sample was collected from different site(Bithor ghat, Siddnath ghat and Dhoni ghat) and different season(Pre monsoon, Monsoon and post monsoon) of river Ganga from Kanpur in 2016-2018 year. Mohr method (Argentometric method) was a very simple and highly selective method for the determination of chloride ion (Cl^-) using silver nitrate as the titrant.

Main Findings: In both the years 2016 till 2018, chloride concentration was within the limit at testing sites.

Applications of this study: To create awareness among the people to maintain the Ganga river water at its highest quality and purity levels.

Originality: This project was done in the D G P G College C S J M University, Kanpur India.

Keywords- Chloride ions, Mohr method, Argentometric, Ganga River, silver nitrate, industrial effluent

INTRODUCTION

The chloride ion is highly mobile and concentrations in water are not affected by chemical reactions. Hence chloride does not biodegrade, readily precipitate, volatilize, or bioaccumulate. The chloride ion does not adsorb readily onto mineral surfaces and therefore concentrations remain high in surface water and sediment pore water, and low in sediment (Mayer et al 1999; Evans and Frick 2001; WHO 2003). High chloride concentration in water are not known to have toxic effects on human although large amount may act corrosively on metal pipes and be harmful to plant life. Chlorides are present in both fresh and salt water, and are essential elements of life. Salts such as table salt are composed of ions that are bonded together. When table salt is mixed with water, its sodium and chloride ions separate as they dissolve. Some research suggests that, with certain exceptions, fish are less sensitive to chloride exposure than small, free-floating planktonic crustaceans (Evans and Frick, 2001). These planktonic animals are a food source for fish and amphibians and help control the algae that contribute to eutrophication, nutrient accumulation that depletes lakes of oxygen. Recent published research suggests that high chloride concentrations are harmful to many aquatic animals.

Freshwater organisms are generally hyperosmotic (internal solute or salt concentration is higher when compared to the surrounding water) and thereby have to continuously excrete water (with some solute loss) to maintain equilibrium. Freshwater organisms therefore have to take up ions to replace the ones lost, which can result in elevated energy expenditures until a threshold of intolerance is reached (Holland et al 2010).

Meador and Carlisle (2007) found chloride tolerance levels for some brook trout species to be as low as 3.1 ppm. Rhode Island's native spotted salamander has a 40% reduction in survival when spawned in a vernal pool with a chloride concentration over 162 ppm. Karraker 2008 experimented that vernal pools, temporary bodies of water, tend to have high chloride concentrations in early spring, when eggs are laid, and in summer, when larvae and tadpoles undergo metamorphosis and become adults, two especially delicate times in their lifecycle. Invasive and fast-growing Eurasian water milfoil is more tolerant of high chloride levels than native plants, thus increasing chloride levels could help them out-compete native fauna (Evans and Frick, 2001).

Hale and Groffman (2006) found that elevated chloride levels interfered with the processes by which bacteria break down nitrogen in suburban stream debris dams, naturally-occurring barriers of sticks, rocks, and other debris. The use of road salts in the northern United States is not likely to end in the near future, the long term effects of chloride in aquatic communities remain to be seen.

Chlorides can also enter a watershed through water softener discharge or sewage contamination. Water softeners remove magnesium and calcium ions from hard water by performing an ionic exchange reaction with sodium chloride. Small amounts of sodium enter water that has passed through the softener, while magnesium chloride and calcium chloride are stored in the device and eventually discharged as brine into a sewer.

Principal: The determination of chloride involves the use of silver nitrate in the presence of potassium chromate as a indicator.

$$Ag^{+} + Cl^{-} = AgCl \text{ (white precipitate)}$$

But when all the chloride ions have been precipitate, a drop of silver nitrate in excess gives a red precipitate of silver chromate. $2Ag^{+} + CrO_4^{2-} = Ag_2CrO_4$

Research Purpose: The research purpose of this study was determining the concentration of chloride ion in water sample which collected different site and season of river Ganga.

MATERIAL AND METHOD

Water samples were collected from 3 different sites of River Ganga at Kanpur during pre-monsoon, monsoon and post monsoon season. Water sample were collected sterile bottle before collection of water, bottle rinsed in $KMnO_4$. Glass vessels were cleaned by using three step – first used concentrated nitric acid (conc. HNO_3) second step rinsed by ethanol and last step cleaned glass vessels several times double distilled deionized water. All required chemicals were purchased from local market and of laboratory reagent grade.

Procedure of Experiment

i. Filter the given water sample so as to remove any suspended material. Pipette out 50 ml of this filtered sample in large porcelain disc and add 3-4 drop of phenolphthalein indicator to it if pink colour just disappear. To the red coloured solution obtained after adding methyl orange indicator add N/50 sodium carbonate solution until the colour of the solution changes to orange.
ii. Transfer the resultant solution in a 250 ml conical flask and add1 ml of potassium chromate indicator. Now add slowly standard N/50 silver nitrate solution from the burette with constant shaking.
iii. A white precipitate of silver chloride will be obtained. Continue the addition process slowely, a red colour will appear in the flask, which disappear on shaking. Now add silver nitrate solution drop by drop until a permanent reddish brown colour is obtained.

Calculation -Chloride(mg/l) = [V_2 (blank sample)-V_1(water sample)] *Normality*35.45*1000/Volume of sample taken

RESULT AND DISCUSSION

The concentration of chloride measured in the Siddnath ghat was higher than concentration measured in Bithor ghat. The values of chlorides range from 31.20 mg/l to 120.44 mg/l. The maximum value (120.44 mg/l) was recorded in the season of pre monsoon of Siddnath ghat river Ganga and minimum value in the season of monsoon and Bithor ghat of river Ganga at kanpur. In the present study maximum value of chloride reaches in the season of pre monsoon in Siddnath ghat of river Ganga.

Table 1: Chloride ion concentration of river Ganga from Kanpur district

S.N.	Season	Sampling station						unit
		2016-2017			2017-2018			
		B G	S G	D G	B G	S G	D G	
1.	Pre monsoon	43.96	113.44	82.24	50.23	120.12	84.05	Mg/l
2.	monsoon	31.20	48.21	38.29	34..67	51.40	41.23	Mg/l
3.	Post monsoon	61.06	92.3	63.9	50.45	80.01	62.83	Mg/l

Increasing chloride in surface waters results in increased salinity, thereby affecting the ability of some organisms (stenohaline more so than euryhaline) to effectively osmoregulate, which could in turn affect endocrine balance, oxygen consumption following chronic exposures, and overall changes in physiological processes (Holland et al 2010).

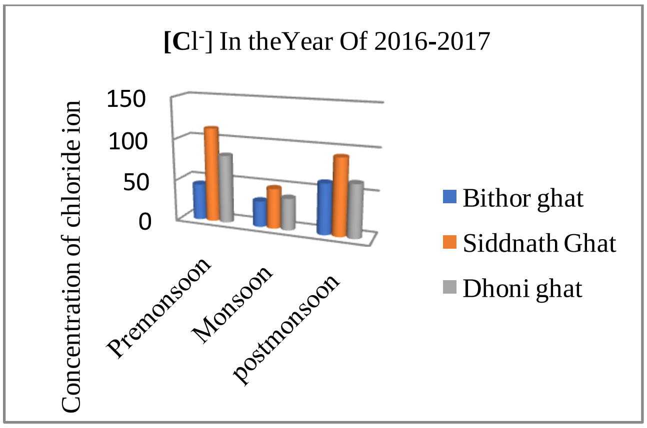

Figure 1: Chloride ion concentration in different sites and season.

In both invertebrates and fish, the main site of osmoregulation is the gill, which is also the site of active uptake of lost salts. The sodium pump is the main mechanism for moving ions across gills in aquatic animals. The mechanism of osmoregulation used is dependent on the life stage of the organism.

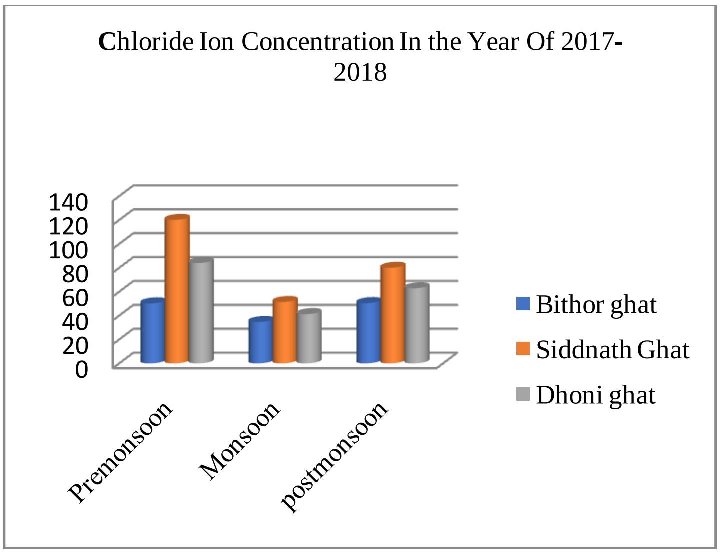

Figure 2. Chloride ion concentration in different sites and season

CONCLUSION

The study carried out in the Kanpur district on river water samples confirm that the chloride ion concentration of river water was within limit. A high chloride content may indicate pollution by sewage or industrial wastes or by the intrusion of seawater or saline water into a freshwater body or aquifer.

LIMITATION AND STUDY FORWARD

A salty taste in water depends on the ions with which the chlorides are associated. Ahigh chloride content has a corrosive effect on metal pipes and structures and is harmful to most trees and plants.

To minimize the concentration of chlorides in Ganga river water at Kanpur will help in selecting the proper experimental methods used for treatment of water. To create increasing awareness among the people to maintain the Ganga river water at its highest quality and purity levels.

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