TO STUDY THE EFFECT OF MASS BATHING ON GANGA RIVER DURING KANWAR MELA, HARIDWAR (UTTARAKHAND)

SUBMITTED BY

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M.Sc. 3rd Semester

ENVIRONMENTAL SCIENCE

GKV, HARDWAR

SUBMITTED TO

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CERTIFICATE

I hereby certify that the project work entitled "Study the Effect of Mass Bathing on Ganga river during Kanwar mela, Haridwar " carried out by Mr. Matul M.Sc. (Environmental Science) 3rd Sem. GKV Haridwar is an authentic record of work carried out by him during June 01, 2017 to August 31, 2017 under my guidance.

We appreciate the sincerity and hard work put by Mr. Matul for completing the task in three months period. I wish him success in him future endeavour.

6.9.17

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Date: 06/09/2017

Place- Haridwar

Matul

MATUL

Content

Chapter - 1

Introduction

Water is the most important natural resource. We depend on water for Irrigation, Industry, Domestic needs, shipping for sanitation and Disposal of wastes. More than 70% of the earth's surface is covered by water. Most of the plants and animal contain more than 60% of water by volume. Without water, life would probably never have developed on our planet.

Water is a transparent and nearly colorless chemical substance that is the main constituent of Earth's streams, lakes, and oceans, and the fluids of most living organisms. Its chemical formula is H_2O, meaning that its molecule contains one oxygen and two hydrogen atoms, that are connected by covalent bonds. Water strictly refers to the liquid state of that substance, that prevails at standard ambient temperature and pressure; but it often refers also to its solid state (ice) or its gaseous state (steam or water vapor). It also occurs in nature as snow, glaciers, icepacks and icebergs, clouds, fog, dew, aquifers,andatmospheric humidity. Water covers 71% of the Earth's surface. It is vital for all known forms of life. On Earth, 96.5% of the planet's crust water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation. Only 2.5% of this water is fresh water, and 98.8% of that water is in ice (excepting ice in clouds) and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products. A greater quantity of water is found in the earth's interior. Water on Earth moves continually through the water cycle of evaporation and transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea. Evaporation and transpiration contribute to the precipitation over land. Large amounts of water are also chemically combined or adsorbed in hydrated minerals. Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack accesses to adequate sanitation. There is a clear correlation between access to safe water and gross domestic product per capita. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A report, issued in November 2009, suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50%. Water plays an important role in the world economy. Approximately 70% of the freshwater used by humans goes to agriculture. Fishing in salt and fresh water bodies is a major source of food for many parts of the world. Much of long-

distance trade of commodities (such as oil and natural gas) and manufactured products is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating, in industry and homes. Water is an excellent solvent for a wide variety of chemical substances; as such it is widely used in industrial processes, and in cooking and washing. Water is also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, and diving.

Water is the most common liquid on Earth. It covers about 71.4% of the Earth. Pure water has no smell, taste, or colour. Lakes, oceans, and rivers are made of water. Precipitation is water that falls from clouds in the sky. It may be rain (liquid) if warm, or it may be frozen if cold. If water gets very cold (below 0 degrees Celsius), it freezes and becomes ice. If water gets very hot (above 100 degrees Celsius), it boils and becomes steam. Water is very important for life.[2] However, some studies suggest that by 2025 more than half the people around the world will not have enough water.

Water is a fluid. Water is the only chemical substance on earth that exists naturally in three states. People know of over 40 anomalies about water. Unlike most other liquids such as alcohol or oil, when water freezes, it expands by about 9%. This expansion can cause pipes to break if the water inside them freezes.

Water is a molecule made of 2 hydrogen atoms and 1 oxygen atom. Its chemical formula is H_2O. Like other liquids, water has a surface tension, so a little water can make drops on a surface, rather than always spreading out to wet the surface. Things having something to do with water may have "hydro" or "aqua" in their name, such as hydropower or aquarium, from the Greek and Latin names for water.

Chapter - 2

Purpose of the Study

Ganga River

The Ganges, also Ganga is a trans-boundary river of Asia which flows through the nations of India and Bangladesh. The 2,525 km (1,569 mi) river rises in the western Himalayas in the Indian state of Utttarakhand, and flows south and east through the Genetic Plain of North India into Bangladesh, where it empties into the Bay of Bengal. It is the third largest river in the world by discharge. The Ganges is the most sacred river to Hindus. It is also a lifeline to millions of Indians who live along its course and depend on it for their daily needs. It is worshipped as the goddess *Ganga* in Hinduism. It has also been important historically, with many former provincial or imperial capitals (suchas Kannauj, Kampilya, Kara, Prayag or Allahabad, Kashi, Pataliputra or Patna, Hajipur, Munger, Bhagalpur, Murshidabad, Baharamp ur, Nabadwip, Saptagram, Kolkata and Dhaka) located on its banks.. The Ganges was ranked as the fifth most polluted river of the world in 2007. Pollution threatens not only humans, but also more than 140 fish species, 90 amphibian species and the endangered Ganges river dolphin. The levels of fecal coliform from human waste in the waters of the river near Varanasi are more than 100 times the Indian government's official limit. The Ganga Action Plan, an environmental initiative to clean up the river, has been a major failure thus far, due to corruption, lack of technical expertise, poor environmental planning, and lack of

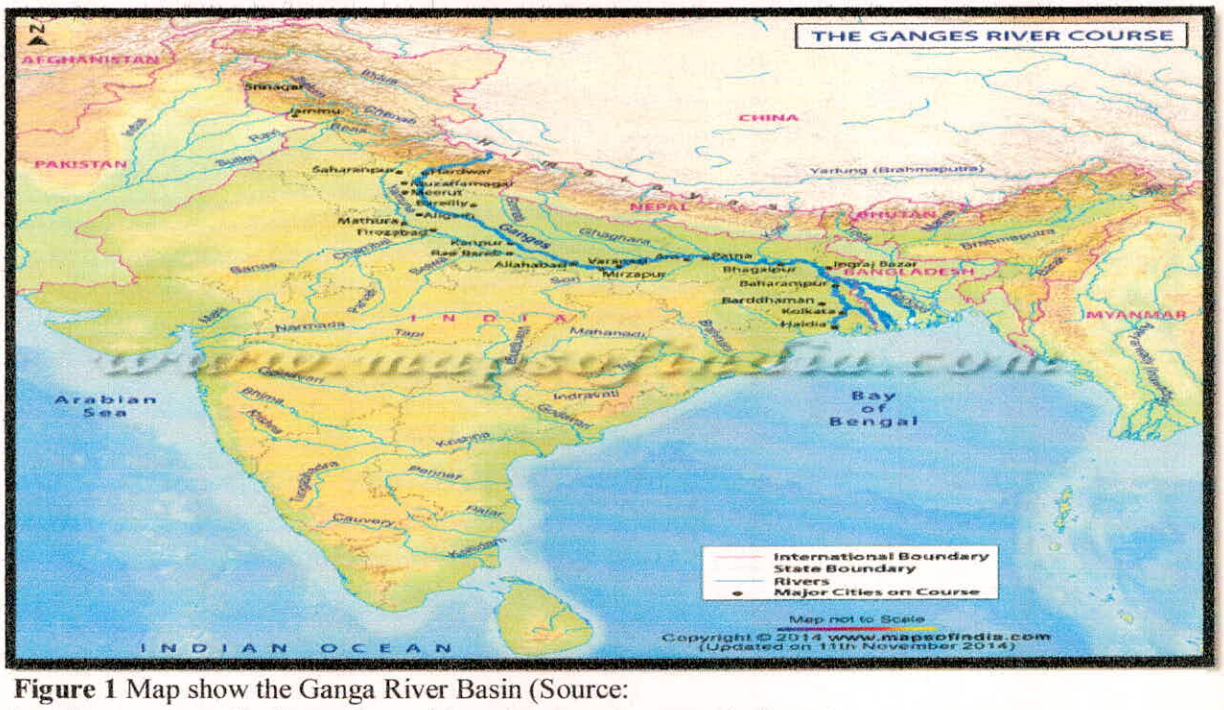


Figure 1 Map show the Ganga River Basin (Source: http://www.mapsofindia.com/maps/rivers/ganges-river-map.jpg)

support from religious authorities.

In Hinduism, the river Ganges is considered sacred and is personified as a goddess Ganga. Some of other names is include Jahanavi, Nikita, Sapteshwari, Urvijaya, Chitrani, Tridhara, Bhaagirathi, Shubhra, Vaishnavi, Vishnupadi, Bhagvatpadi, Tripathaga,

Payoshnika, Mahabhadra, Mandakini, Meghal, Gangika, and Gangeshwari. She is worshiped by Hindus who believe that bathing in the river causes the remission of sins and facilitates Moksha (liberation from the cycle of life and death), and that the water of the Ganges is considered very pure. Pilgrims immerse the ashes of their kin in the Ganges, which is considered by them to bring the spirits closer to moksha. In Hinduism, moksha is the liberation from the cycle of life and death.

Ganga is described as the melodious, the fortunate, the cow that gives much milk, the eternally pure, the delightful, the body that is full of fish, affords delight to the eye and leaps over mountains in sport, the bedding that bestows water and happiness, and the friend or benefactor of all that lives. Ganga is a holy river according to Hinduism it as a great

Figure 2 Showing the Kanwar mela rush (Source: Capturing by Camera during kanwar mela)

importance in the life style of Hindu. In a year thousand crore people come there for reglious puposess among them Kawar is one of the important time.

The Kanwar (Kavad) Yatra is an annual pilgrimage of devotees of Siva, known as Kanvarias or "Bhole" to Hindu pilgrimage places of Haridwar, Gaummukh and Gangotri in Uttarakhand

and Sultanganj in Bihar to fetch holy waters of Ganges River. Millions of participants gather sacred water from the Ganga and carry it across hundreds of miles to dispense as offerings in their local Siva shrines, or specific temples such as Pura Mahadeva and Augharnath temple in Meerut, and Kashi Vishwanath, Baidyanath, and Deoghar in Jharkhand. At its base, Kanwar refers to a genre of religious performances where participants ritually carry water from a holy source in containers suspended on either side of a pole. The pilgrimage derives its name from the contraption, called kanwar, and while the source of the water is often the Ganga, it can also be its local equivalents. The offering is dedicated to Siva, often addressed as Bhola (Simple One) or Bhole Baba (Simple Grandfather/Father). The pilgrim, accordingly, is a bhola, and in the vocative, bhole! Although there is little mention of the Kanwar as an organized festival in canonical texts, the phenomenon surely existed in the early nineteenth century when English travelers report seeing Kanwar pilgrims at many points during their journeys in the north Indian plains. The Yatra used to be a small affair undertaken by a few saints and older devotees until the late 1980s, when it started gaining popularity. Today, the Kanwar

pilgrimage to Haridwar in particular has grown to be India's largest annual religious gathering, with an estimated 12 million participants in the 2010 and 2011 events. The devotees come from the surrounding states of Delhi, Uttar Pradesh, Haryana, Rajasthan, Punjab, Bihar and some from Jharkhand, Chhattisgarh and Madhya Pradesh. Heavy security measures are undertaken by the government and the traffic on Delhi-Haridwar national highway (National Highway 58) is diverted for the period.

Mass Bathing

According to Hindu mythology, Haridwar is one of the holiest places, on account of the belief that the Gods have left their footprints in Haridwar. The holy city of Haridwar is site to some of the most sacred Hindu rituals and one can always see pilgrims and devotees from round the globe gather at Haridwar to offer prayers on auspicious occasions, having a dip in the sacred Ganga River. Millions of devotees and visitors, take a dip in the holiest river Ganga during Kanwar, Ardh-Kumbh, Maha Kumbh and other festive occasionsIt is not possible for any city municipality to make proper arrangements for lodging and other civic facilities for millions pilgrims during festive occasions. Haridwar city is famous for such big festive occasions like Kanwar, Ardh-Kumbh and Maha Kumbh. As a consequence of insufficient facilities, the available places, grounds, fields and riparian city forest areas are used as latrines and toilets. The municipal water points turn as quick wash places. The 4-5 Km stretch of Ganga River and river canal banks are used as bathing places and sites of holy water collection, too. The pilgrims also offer flowers, cloths, old icons of Gods and Goddess, besides last remains (ashes) of their loved ones to dispose in the river Ganga, at Haridwar.

In the month of July, heavy influx of pilgrims poured in Haridwar city to attend the Kanwar for taking a holy dip in river Ganga to wash away their past sins. According to news papers and local administration, more than 1 crore pilgrims took holy dip in river Ganga at Haridwar during Kanwar every year. It can be well presumed that such a massive bathing would affect the quality of water of any riverine ecosystem. Therefore, a chemical analysis of water was done to assess the impact of mass bathing

Chapter - 3

Study Area and Sampling

Sampling Site

The sampling site of water is carried out in the district Haridwar, Uttrakhand (India) Uttrakhand is a state located in the northern part of the India. It extends from 28° 43′ N to 31° 27′ N longitude and 77° 34′ east to 81° 02′ latitude and Haridwar

Lat: 29 56'44'' N, long: 78'03'51''E

Following two different sites have been selected to collect the water samples and analysis the mass bathing effect on Ganga River.

Table 1: Details of sampling sites at different locations with coordinates

Site	Name of Landmark	Geo Coordinate
Site 1	Near Chilla Power Plant	30°01'53.83'' N 78°15'41.82'' E
Site 2	Har ki Pauri	29°51'23.34'' N 78° 10'16.65'' E

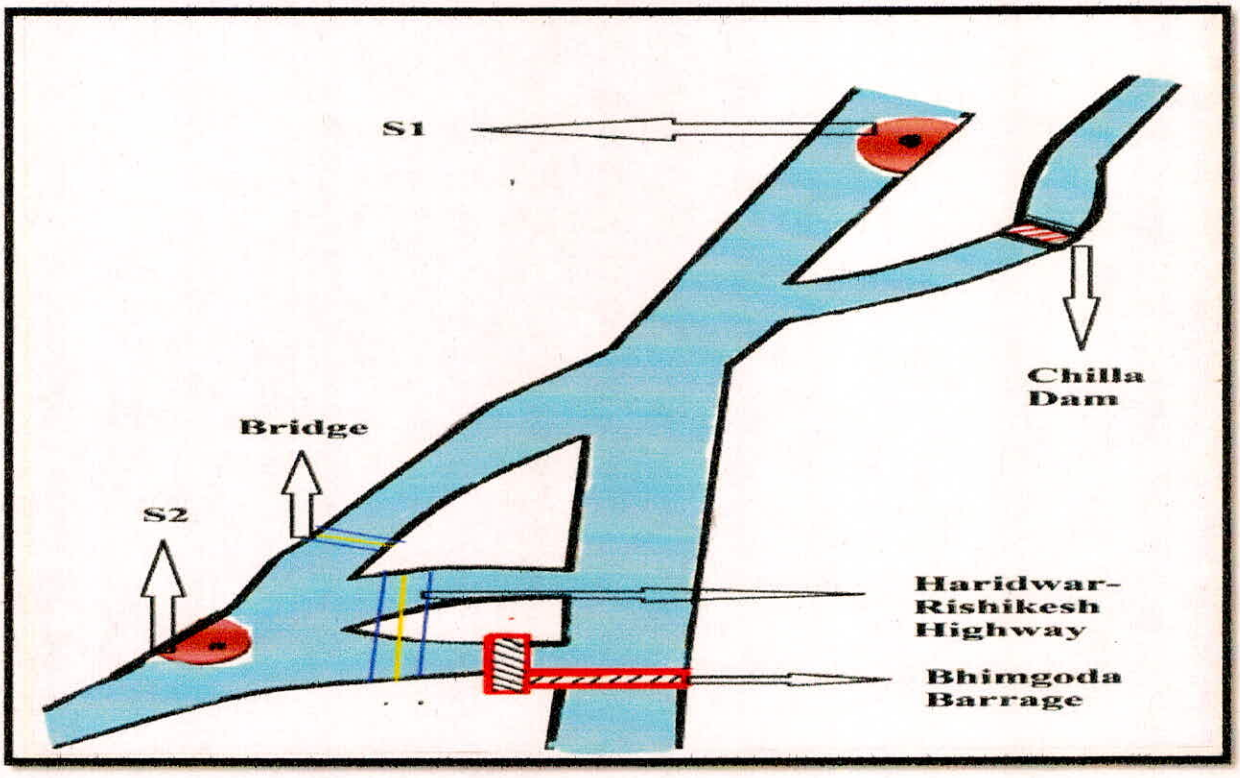


Figure 3 Sketch Map Showing the different sampling sites at district Haridwar

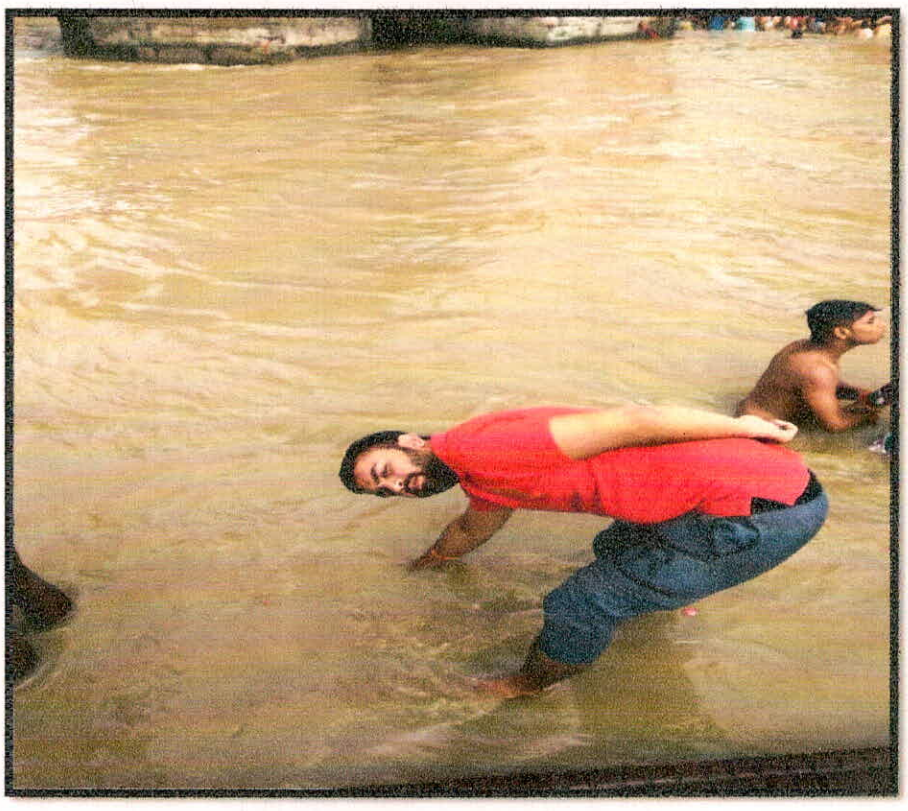


Figure 4 While sampling at Har ki Pauri

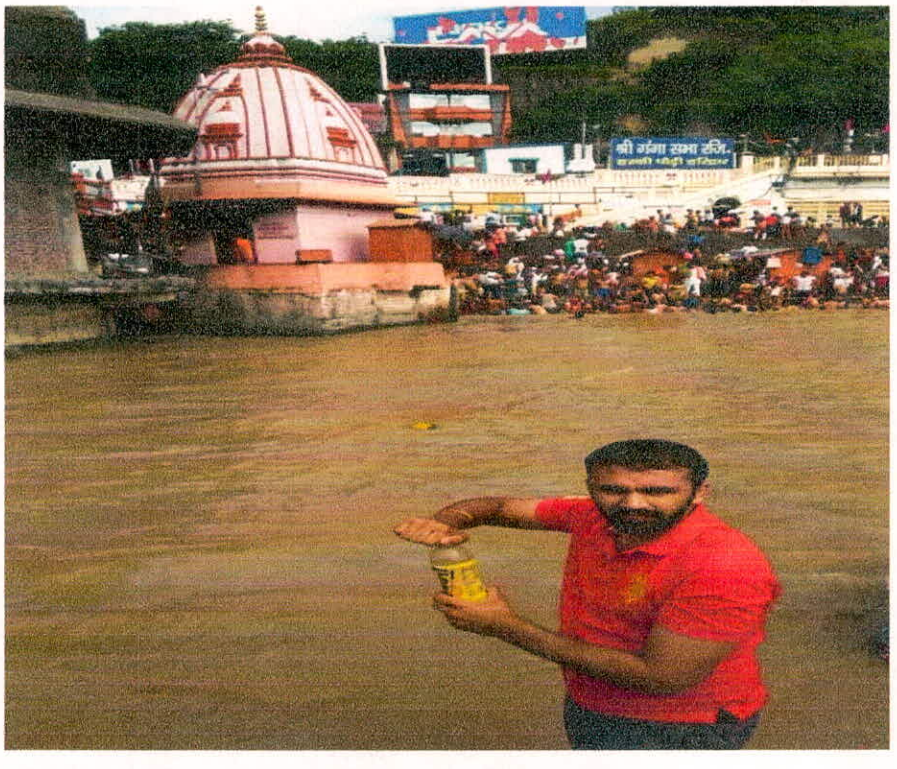


Figure 5 Tighten the bottle cap after sample have been taken

Chapter - 4

Ion Chromatography

What is Chromatography?

Chromatography is a laboratory technique for the separation of a mixture. The mixture is dissolved in a fluid called the *mobile phase,* which carries it through a structure holding another material called the *stationary phase.* The various constituents of the mixture travel at different speeds, causing them to separate. The separation is based on differential partitioning between the mobile and stationary phases. Subtle differences in a compound's partial cooperation result in differential retention on the stationary phase and thus affect the separation.

Chromatography may be preparative or analytical. The purpose of preparative chromatography is to separate the components of a mixture for later use, and is thus a form of purification. Analytical chromatography is done normally with smaller amounts of material and is for establishing the presence or measuring the relative proportions of analyses in a mixture.

The twelve types are: (1) Column Chromatography (2) Paper Chromatography (3) Thin Layer Chromatography (4) Gas Chromatography (5) High Performance Liquid Chromatography (6) Fast Protein Liquid Chromatography (7) Supercritical Fluid Chromatography (8) Affinity Chromatography (9) Reversed Phase Chromatography (10) Two Dimensional Chromatography (11) Pyrolysis Gas Chromatography and (12) Counter Current Chromatography

Methods of Chromatography

Based on the polarities of the stationary and mobile phases a distinction is made between the following methods:

Group 1	**Group 2**
Traditional TLC + HPLC	Ion Chromatography
1.normal phase chromatography 2.reversed phase chromatography	1. Ion exchange chromatography 2. Ion pair chromatography 3. Ion exclusion chromatograph

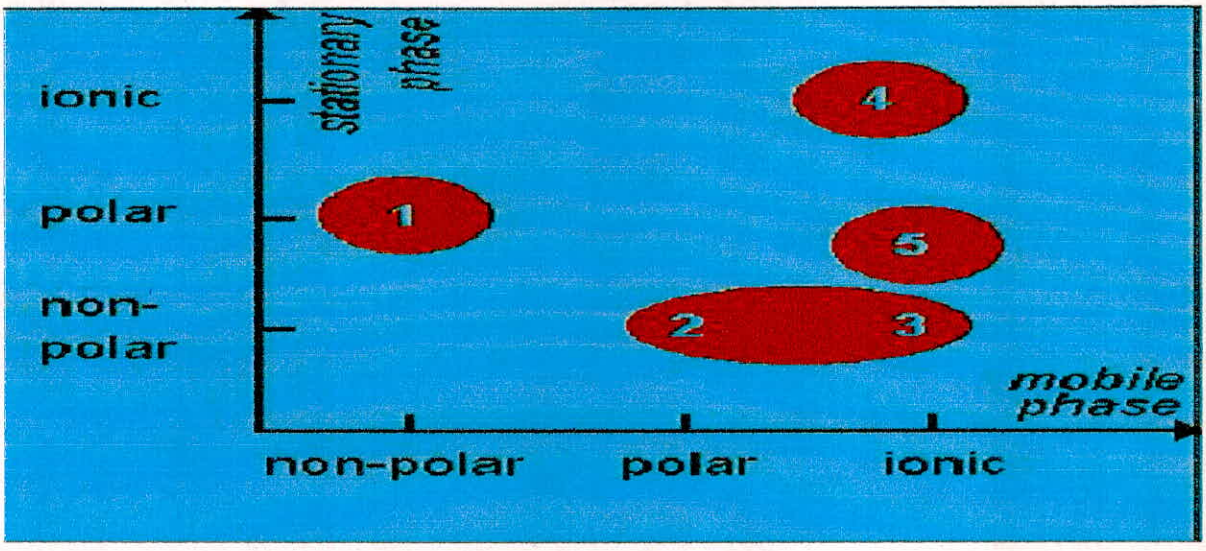


Figure 6 Showing the various among Chromatography

Ion Chromatography is a form of liquid chromatography. It is used to determine anions and cations in aqueous samples. Ion exchange resins packed into columns are used as the stationary phase. It works on almost any kind of charged molecule—including large proteins, small nucleotides, and amino acids. The two types of ion chromatography are anion-exchange and Cation-exchange. It is often used in protein purification, water analysis, and quality control. The water-soluble and charged molecules such as proteins, amino acids, and peptides bind to moieties which are oppositely charged by forming ionic bonds to the insoluble stationary phase. The equilibrated stationary phase consists of an ionisable functional group where the targeted molecules of a mixture to be separated and quantified can bind while passing through the column—a cationic stationary phase is used to separate anions and an anionic stationary phase is used to separate cations. Cation exchange chromatography is used when the desired molecules to separate are cations and anion exchange chromatography is used to separate anions. The bound molecules then can be eluted and collected using an eluent which contains anions and cations by running higher concentration of ions through the column or changing pH of the column. One of the primary advantages for the use of ion chromatography is only one interaction involved during the separation as opposed to other separation techniques; therefore, ion chromatography may have higher matrix tolerance. However, there are also disadvantages involved when performing ion-exchange chromatography, such as constant evolution with the technique which leads to the inconsistency from column to column.

The term chromatograph is the general name for a wide range of physicochemical separation processes in which the components to be separated are distributed between a stationary and a mobile phase

Mobile phase : gaseous, liquid

Stationary phase: liquid → GLC, LLC

Solid → GSC, LSC, (HPLC - IC)

Ion exchange chromatography, which is also known as adsorption chromatography, is a useful and popular method due to its;

- high capacity,
- high resolving power,
- mild separation conditions,
- versatility and wide speared applicability,
- tendency to concentrate the sample
- Relatively low cost.

General components of an ion-exchange chromatography are presented as below;

- A high pressure pump with pressure and flow indicator, to deliver the eluent
- An injector for introducing the sample into the eluent stream and onto the column
- A column, to separate the sample mixture into the individual components
- An oven, optional
- A detector, to measure the analyte peaks as eluent from the column
- A data system for collecting and organizing the chromatograms and data

Principle of Ion Chromatography

Ion-exchange chromatography separates molecules based on their respective charged groups. Ion-exchange chromatography retains analyte molecules on the column based on coulombic (ionic) interactions essentially, molecules undergo electrostatic interactions with opposite charges on the stationary phase matrix. The stationary phase consists of an immobile matrix that contains charged ionisable functional groups or ligands. The stationary phase surface displays ionic functional groups (R-X) that interact with analyte ions of opposite charge

Cation exchange chromatography retains positively charged cations because the stationary phase displays a negatively charged functional group

$$R-X^{-}C^{+}+M^{+}B^{-} \Leftrightarrow R-X^{-}M^{+}+C^{+}+B^{-}$$

Anion exchange chromatography retains anions using positively charged functional group:

$$R-X^{+}A^{-}+M^{+}B^{-} \Leftrightarrow R-X^{+}B^{-}+M^{+}+A^{-}$$

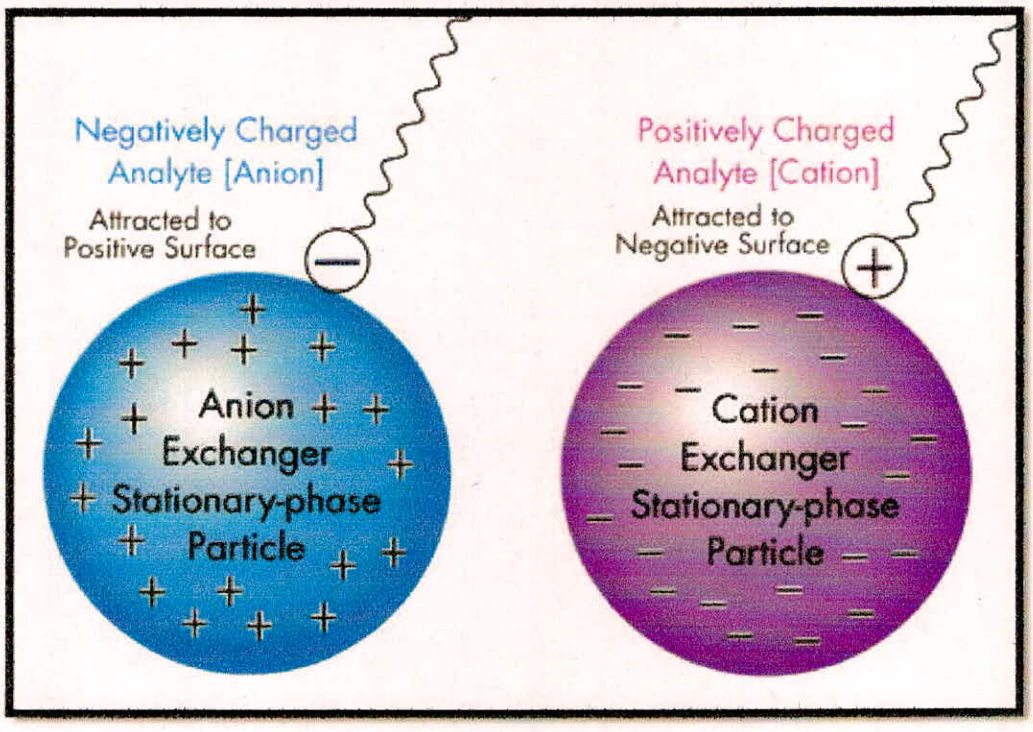


Figure 7 Showing the Principle working of IC (Source: http://www.waters.com/webassets/cms/category/media/other_images/primer_T_Ion_Exchange_CHromatography.jpg)

Ion exchange chromatography

Cations and anions form a weak ionic binding with the stationary phase.

C: Stationary p. = (e.g. R-SO3–)

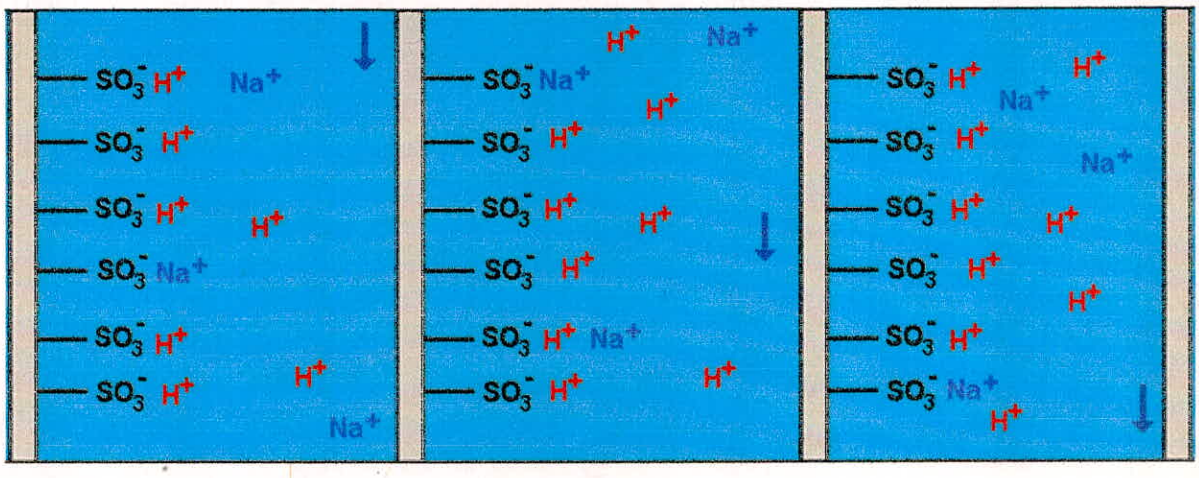
Mobile p. = (e.g. HNO3 aq.)

A: Stationary p. = (e.g. R-NR3+)

Mobile p. = (e.g. Na2CO3 a

Cation separation mechanism

Stationary phase and mobile phase compete for the analyte



Retention time increase with the increase in time

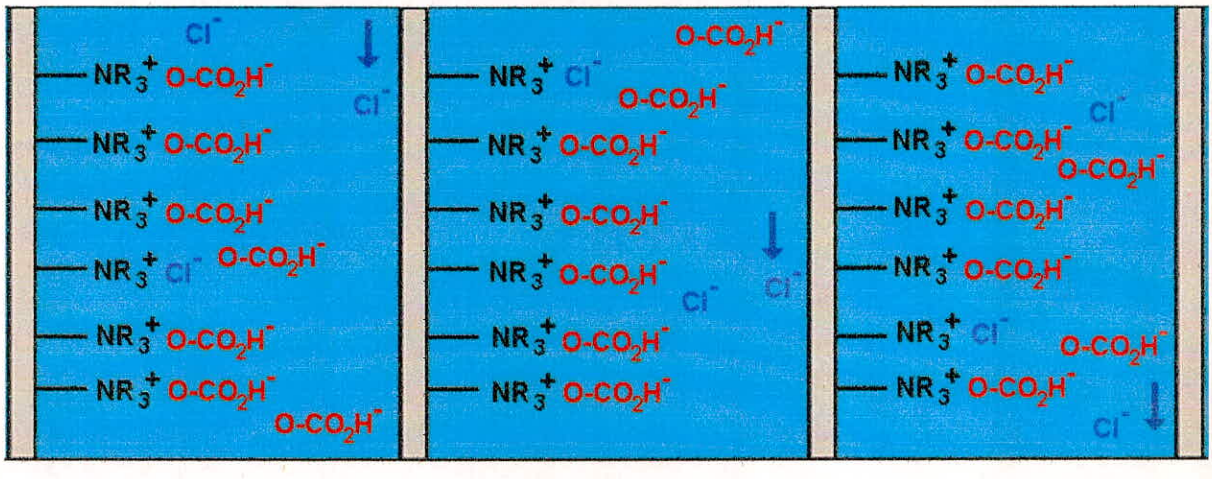
Monovalent < Divalent < Trivalent

More charge leads to more interaction

and more the retention

Anion separation mechanism

Stationary phase and mobile phase compete for the analyte



Instrumentation

Typical IC instrumentation includes: pump, injector, column, suppressor, detector and recorder.

- Pump- The IC pump is considered to be one of the most important components in the system which has to provide a continuous constant flow of the eluent through the IC injector, column, and detector. The most practical system for the delivery of the mobile phase is that which can combine several liquids in different proportions at the command of the operator. The mobile phase passes from the pump to the sampling device, usually a simple rotating valve that on rotation places the sample in line with the mobile flow which then passes onto the column. The constant-flow pumps are the most widely used in all common IC applications. Flow rate stability is an important pump feature that distinguishes pumps.
- Injector- Sample introduction can be accomplished in various ways. The simplest method is to use an injection valve. In more sophisticated liquid chromatography, automatic sampling devices are incorporated where sample introduction is done with the help of auto-samplers. In liquid chromatography, liquid samples may be injected directly and solid samples need only to be dissolved in an appropriate solvent. It is always best to remove particles from the sample by filtering, or centrifuging since continuous injection of particulate materials will eventually cause blockage of injection devices or columns. Injectors should provide the possibility of injecting the liquid sample within the range of 0.1 to 100 ml of volume under high pressure (up to the 4000 psi). The most useful and widely used sampling device for is the micro sampling injector valve. With these sampling valves, samples can be introduced reproducibly into pressurized columns without significant interruption of flow.
- Column- Ion exchange columns vary widely in size, packing material and material of construction. Depending on its ultimate use and area of application, the column material may be stainless steel, titanium, glass or an inert plastic such as PEEK (PolyEtherEtherKetone). The column can vary in diameter from about 2 mm to 5 cm and in length from 3 cm to 50 cm depending on whether it is to be used for normal analytical purposes, microanalysis, high speed analyses or preparative work. The life of a column will depend largely on the type of samples it is used to separate but the conditions under which the separations are carried out will also place limits on it useful lifetime.

- Suppressor- The suppressor reduces the background conductivity of the chemicals used to elute samples from the ion-exchange column which improves the conductivity measurement of the ions being tested. Ion chromatography suppressors are membrane-based devices. They remove the interference resulting from the presence of ionic salts in the eluent. Suppressors are normally used with purely aqueous eluent. For utilization in industry, the electrolytic suppressor is usually more appropriate and is fully automated in terms of response to changing eluent conditions. Care needed to be taken with controlling the suppressor current in order to avoid damage to the suppressor.
- Detector- Current ion chromatography detectors have a wide dynamic range normally allowing both analytical and preparative scale runs on the same instrument. An ideal detector should have the following properties: low drift and noise level (particularly crucial in trace analysis), high sensitivity, fast response, low dead volume (minimal peak broadening), cell design which eliminates remixing of the separated bands, insensitivity to changes in type of the solvent, flow rate and temperature, operational simplicity and reliability. It should be non-destructive.

Electrical conductivity detector is commonly use. The sensor of the electrical conductivity detector is the simplest of all the detector sensors.

Figure 8 Showing the parts of IC (Source: https://www.iitk.ac.in/cese/Facilities/img/ic.JPG)

Flow Chart

- The sample solution is injected into loop by injection port.
- The pump pushes the solvent through the loop taking the sample and caring it into the analytical column.
- The analytes separated by the analytical column reach the detector (UV spectrophotometer, conductivity detector) in different times.
- An interface links the ion chromatography instrumentation to the pc. The chromatogram is displayed on the pc screen.

Eluent Pump Injector Column Suppressor Detector

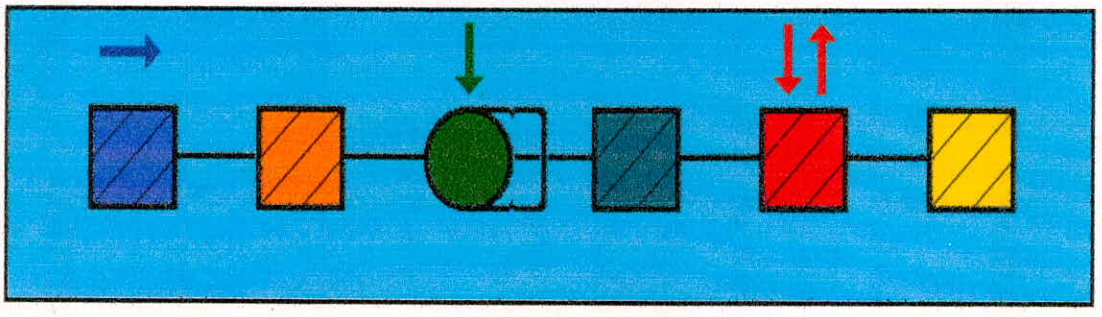


Figure 9 showing the flow diagram of IC (Source: https://www.intechopen.com/source/html/43603/media/image13_w.jpg)

Application

Since its introduction in 1975 ion chromatography (IC) has developed and matured into an important analytical methodology that is applied in a number of diverse applications and industries. This technique has gained popularity in laboratories for determination of ions such as inorganic anions and cations (including alkaline metals, alkaline earth metals, transition metals, and rare earth metals), organic acids, carboxylic, phosphoric and sulphuric acids; detergents, carbohydrates, organic bases (e.g. amines) and ionic forms of metal/metalloids on different oxidation states and in environmental, agricultural, pharmaceutical industries.

Ion exchange chromatography has many uses including:

Separation of proteins from foods. For example, to investigate the effects of individual food components on health – this type of analysis is used in nutrition research.

Used for the softening of water- A strongly acidic Cation exchange resin is used here in the sodium form. The ions forming hardness, essentially calcium and magnesium, are exchanged for the sodium ions of the resin, and the softened water can be used for several purposes:

Laundries

Domestic water boilers

Low pressure industrial boilers.

Demineralization of water- All ions must be removed from water. Therefore the water passes first through Cation exchange resins in the hydrogen form, then through anion exchange resins in the hydroxyl or free base form. All cations are replaced by ions from the cation resin, and all anions for the ions of the anion resin. These H^+ and OH^- ions recombine to create new water molecules (H_2O).

Drinking water analysis for pollution and other constituents.

Determination of sugar and salt content in foods.

Proteins are also successfully separated by this technique.

It is also used for the separation of many vitamins, other biological amines, and organic acids and bases.

Industrial and analytical ion chromatography is another area to be mentioned. Ion chromatography is a chromatographical method that is widely used for chemical analysis and separation of ions. For example, in biochemistry it is widely used to separate charged molecules such as proteins. An important area of the application is extraction and purification of biologically produced substances such as proteins (amino acids) and DNA/RNA.

Advantages

- Shorter analysis time for simpler sample (generally 10-12 minute)
- small sample volume
- Powerful separation
- Its work for Polar molecules very well.
- Used in water testing labs
- Usage of cheap, safe and environmental friendly chemicals.

Disadvantages

- Soil, sediment, geological sample preparation is more extensive.
- Longer analysis time for more complex samples.
- Can't select specific compounds for high speed analysis.
- Turbidity should be below 10 ppm
- Costly equipment and more expensive chemicals

Chapter - 5

Result and Conclusion

Result

Table-1 Showing the Results of Anions

Site	Date	pH	EC (µS/cm)	Total Hardness by IC (mg/L)	F (mg/L)	Cl (mg/L)	No_3 (mg/L)	No_2 (mg/L)	PO_4 (mg/L)	SO_4 (mg/L)
S_1	11/01/2017	8.1	167.6	77.879	--	0.477	0.009	1.803	0.039	9.466
S_2	11/07/2017	8.1	208.3	98.668	0.117	0.737	--	20.458	0.036	15.038
S_1	21/07/2017	7.9	136.5	64.747	0.055	0.349	0.303	0.758	--	9.970
S_2	21/07/2017	8.1	181.3	83.902	--	0.875	--	1.691	0.046	15.574

S_1 and S_2 are the two sampling sites

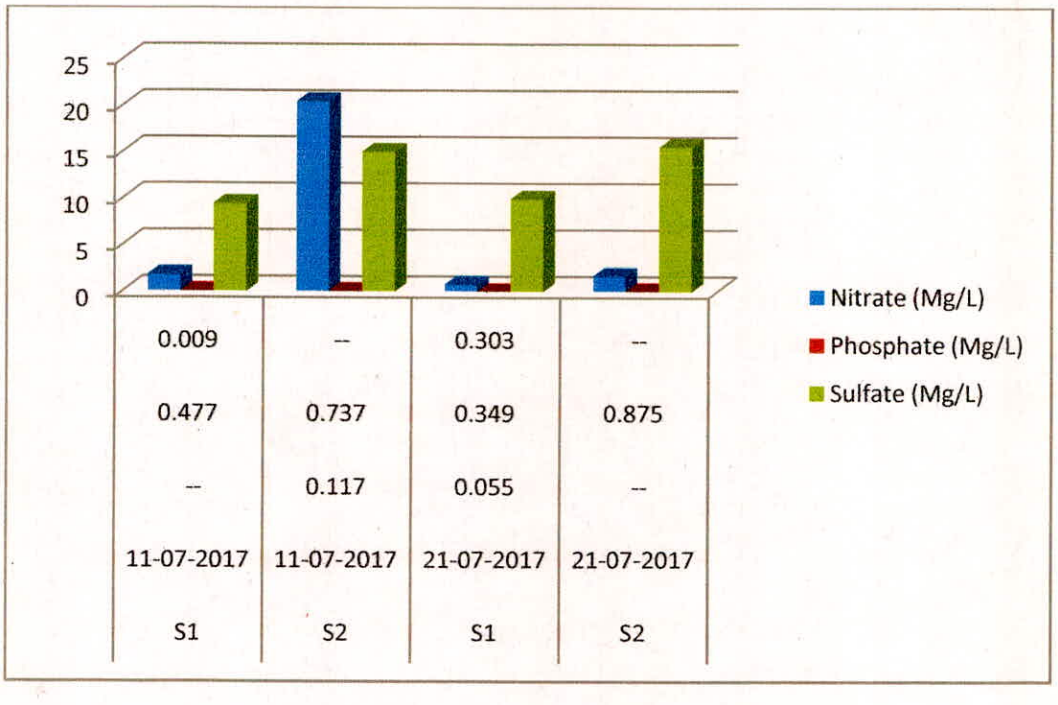


Figure 10 Variation in the concentrartion of Anion at the Selected Sites

Table: 2 Showing the Result of Cations

Site	Date	Sodium (Mg/L)	Ammonium (Mg/L)	Potassium (Mg/L)	Calcium (Mg/L)	Magnesium (Mg/L)
S_1	11/07/2017	1.533	0.105	3.736	26.346	2.956
S_2	11/07/2017	1.782	0.121	3.616	31.732	4.737
S_1	21/07/2017	1.389	0.15	1.948	20.961	3.025
S_2	21/07/2017	1.963	0.257	2.197	25.224	5.096

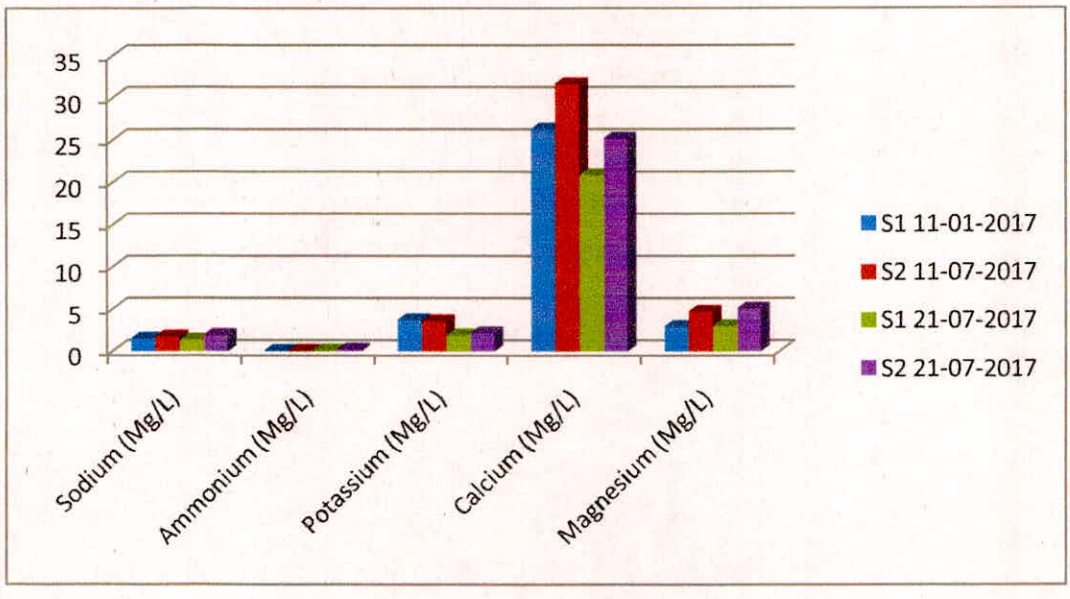


Figure 11 Varitation in the concentrartion of Cations in the selected sites

NIH IC REPORT

Date2017-08-09 18:12:10 UTC+5:30

S1 -11/07/17

Anion

Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Chloride	8.40	0.439	0.117	0.477
Nitrite	10.42	0.004	0.001	0.009
Nitrate	14.44	0.581	0.249	1.803
phosphate	21.10	0.003	0.002	0.039
Sulfate	24.41	3.096	1.644	9.466

Cation

Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Sodium	11.23	1.307	0.343	1.533
Ammonium	13.12	0.033	0.010	0.105
Potassium	19.87	0.810	0.399	3.736
Calcium	27.77	4.820	4.210	26.346
Magnesium	39.08	1.241	1.048	2.956

% Error----------.2.696
Sample pH----------8.1
M-alkalinity as CaCO3----------69.786
P-alkalinity as CaCO3----------0.000
Total Hardness by IC----------77.897

EC = 167.6 µS/cm

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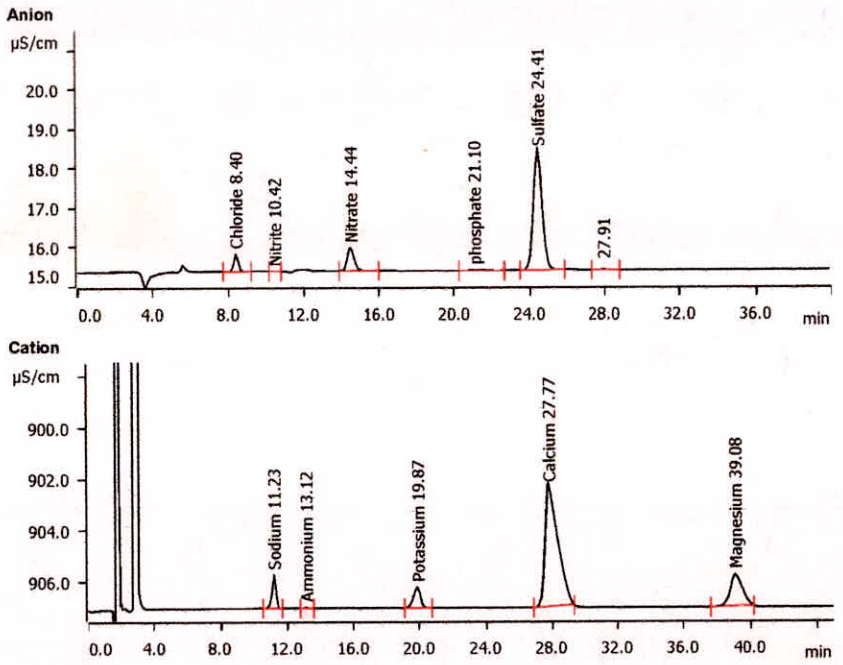

NIH IC REPORT

Date2017-08-09 19:02:10 UTC+5:30

S2 -11/07/17

Anion

Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Fluoride	5.60	0.163	0.044	0.117
Chloride	8.42	0.674	0.180	0.737
Nitrate	14.51	0.785	0.340	2.458
phosphate	21.09	0.003	0.002	0.036
Sulfate	24.38	4.939	2.611	15.038

Cation

Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Sodium	11.26	1.499	0.399	1.782
Ammonium	13.17	0.033	0.012	0.121
Potassium	19.99	0.778	0.386	3.613
Calcium	27.56	5.437	5.071	31.732
Magnesium	38.79	1.904	1.680	4.737

% Error----------.3.626
Sample pH----------8.1
M-alkalinity as CaCO3----------81.000
P-alkalinity as CaCO3----------0.000
Total Hardness by IC----------98.668

EC = 208.3 µS/cm

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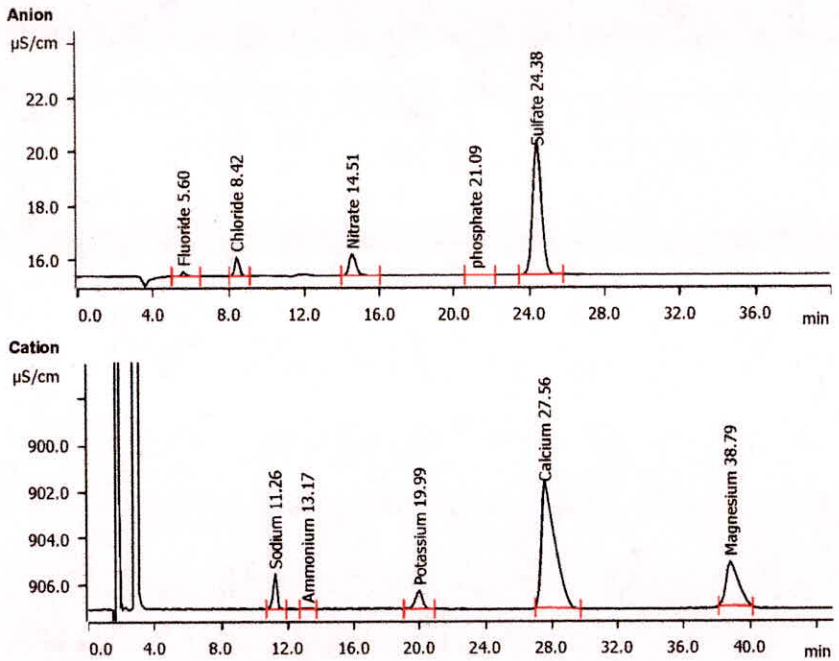
Date2017-08-09 19:02:10 UTC+5:30



NIH IC REPORT

Date2017-08-09 16:13:46 UTC+5:30

S1 -21/07/17

Anion

Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Fluoride	5.70	0.134	0.021	0.055
Chloride	8.58	0.361	0.085	0.349
Nitrite	11.92	0.057	0.043	0.303
Nitrate	14.79	0.265	0.105	0.758
Sulfate	25.66	3.318	1.731	9.970

Cation

Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Sodium	11.44	1.171	0.311	1.389
Ammonium	13.39	0.045	0.015	0.150
Potassium	20.17	0.425	0.208	1.948
Calcium	29.15	3.858	3.349	20.961
Magnesium	41.00	1.221	1.073	3.025

% Error----------.4.398
Sample pH----------7.9
M-alkalinity as CaCO3----------52.807
P-alkalinity as CaCO3----------0.000
Total Hardness by IC----------64.747

EC = 136·5 µS/cm

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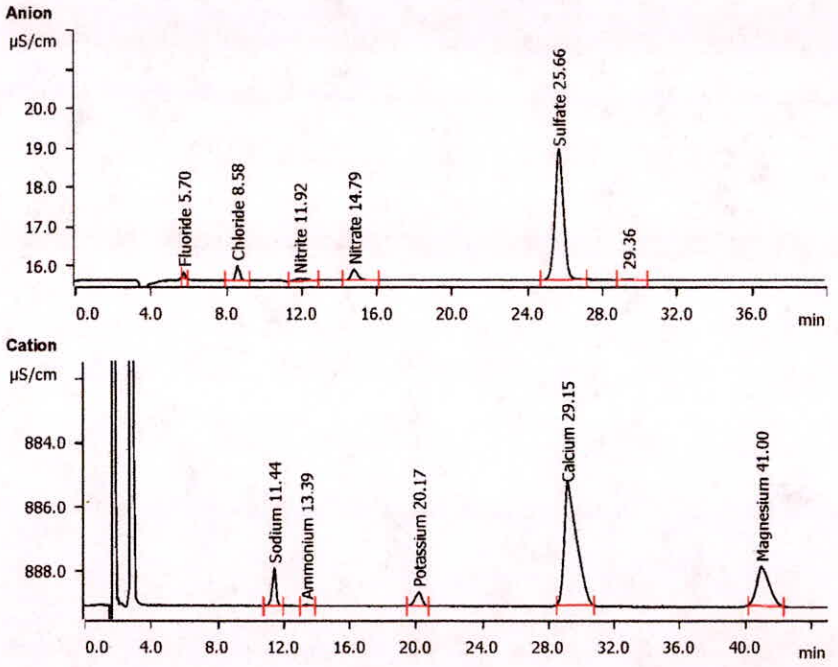
Date2017-08-09 16:13:46 UTC+5:30



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Date2017-08-09 17:22:24 UTC+5:30

S2 -21/07/17

Anion

Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Chloride	8.38	0.405	0.107	0.875
Nitrate	14.35	0.268	0.117	1.691
phosphate	21.00	0.002	0.001	0.046
Sulfate	24.40	2.531	1.352	15.574

Cation

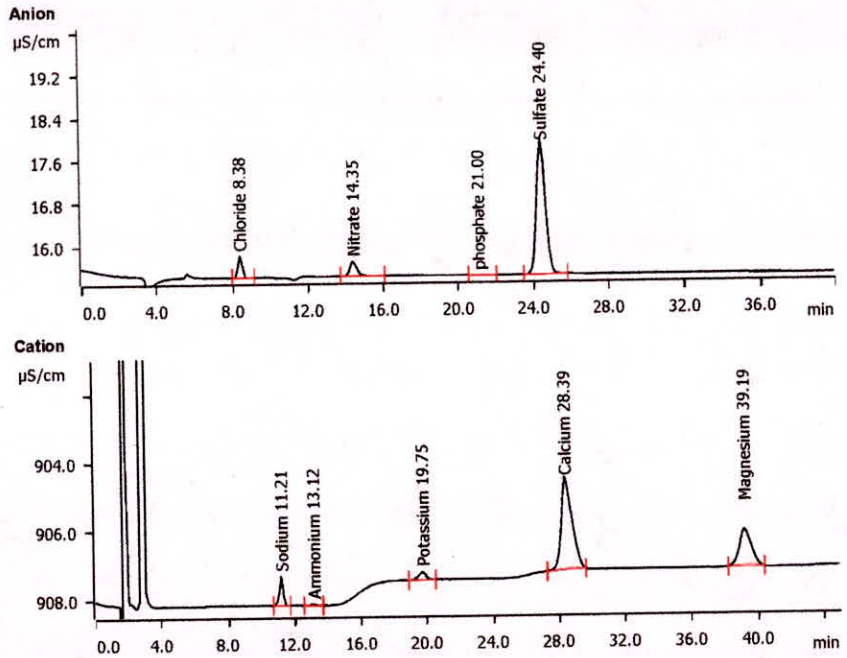
Component name	Retention time	Height	Area	Concentration
	min	µS/cm	(µS/cm) x min	mg/L
Sodium	11.21	0.845	0.220	1.963
Ammonium	13.12	0.034	0.013	0.257
Potassium	19.75	0.234	0.117	2.197
Calcium	28.39	2.708	2.015	25.224
Magnesium	39.19	1.083	0.904	5.096

% Error----------.2.965
Sample pH----------8.1
M-alkalinity as CaCO3----------67.557
P-alkalinity as CaCO3----------0.000
Total Hardness by IC----------83.902

EC = 181·3 µS/cm

NIH IC REPORT

Date2017-08-09 17:22:24 UTC+5:30



Conclusion

During the study period in Kanwar the concentration of Cations and Anions shows some fluctuation in their values. The pH values vary in between 7.9-8.1. The EC (µS/cm) values shows same decrease during the time of mass bathing 167.6 to 136.5 and 208.3 to 181.3 at S_1 and S_2 respectively. . Total Hardness by IC (mg/L) was 77.897 to 64.747 at S_1 and 98.668 to 83.902 at S_2.

At S_1 the concentration of Chloride (mg/L) before mass bathing is 0.477 and after mass bathing the concentration become is 0.349. Similar in site S_2 Chloride concentration is 0.743 before the mass bathing and after the mass bathing is 0.875. At site S_1 the value of Nitrite (mg/L) is 0.009 and after mass bathing is 0.303. At site S_1 the value of Nitrate (mg/L) is 1.803 and after mass bathing is 0.758. At site S_2 the value of Phosphate (mg/L) is 0.036 and after mass bathing is 0.046. At site S_1 the value of Sulfate (mg/L) is 9.466 and the after mass bathing is 9.970 similarly at site S_2 the value before mass bathing is 15.038 and after the mass bathing is 15.574.

While studying about the Cations at site S_1 the value of Sodium (mg/L) before mass bathing is 1.53 and after mass bathing is 1.389 at site S_2 the value before mass bathing is 1.782 and after the mass bathing is 1.963. At site S_1 the value of Ammonium (mg/L) before mass bathing is 0.105 and after mass bathing is 0.150 at site S_2 the value before mass bathing is 0.121 and after the mass bathing is 0.257. At site S_1 the value of Potassium (mg/L) before mass bathing is 3.376 and after mass bathing is 1.948. At site S_2 the value before mass bathing is 3.613 and after the mass bathing are 2.197. At site S_1 the value of Calcium (mg/L) before mass bathing is 26.346 and after mass bathing is 20.961. At site S_2 the value before mass bathing is 31.732 and after the mass bathing are 25.224. At site S_1 the value of Magnesium (mg/L) before mass bathing is 2.956 and after mass bathing is 3.025. At site S_2 the value before mass bathing is 4.737 and after the mass bathing are 5.096

During the study it was observed that concentration of At S_1 the values of Chloride, Nitrate, Sodium, Potassium, Calcium also shows some decrease while increase in the value of Nitrite, Sulfate, Magnesium before and after the mass bathing and while studying about the S_2 the value of Chlorine, Nitrate, Sulfate, Sodium, Magnesium increased and Phosphate, Potassium, Ammonium, Calcium decreases.